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The Department of Defense and the US Navy have existing policies and regulations to ensure that the use of hazardous materials is controlled in the manner which protects human health and the environment at the least cost. Hazardous Material Control and Management (HMC&M), implemented under OPNAVINST 4110.2, is a Navy-wide program that requires controlling and managing hazardous materials on a life-cycle basis in order to minimize the generation of hazardous waste. HMC&M actions are required from initial system concept formulation on through the research, development, acquisition, production, operation, and final disposition phases.

The overall objective is to increase user's perceptions of how to ensure operation readiness while reducing hazards to life, property, and the environment through the application of a rational, systematic methodology to select the least hazardous materials consistent with life cycle cost and operational considerations.

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"GUIDANCE MANUAL FOR INTEGRATING HMC&M INTO SYSTEM ACQUISITION PROGRAMS"

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FOREWORD

The Department of Defense and the US Navy have existing policies and regulations to ensure that the use of hazardous materials is controlled in a manner which protects human health and the environment at the least cost. Hazardous Material Control and Management (HMC&M), implemented under OPNAVINST 4110.2, is a Navy-wide program that requires controlling and managing hazardous materials on a life-cycle basis in order to minimize the generation of hazardous waste. HMC&M actions are required from initial system concept formulation on through the research, development, acquisition, production, operation, and final disposition phases.

The "Guidance Manual For Integrating HMC&M Into System Acquisition Programs" is a compilation of information from four Technical Reports prepared for the Naval Supply Systems Command (NAVSUP). The four Technical Reports addressed the key activities involved in incorporating HMC&M elements into the integrated logistics support process, selecting/substituting the least hazardous materials, performing HMC&M economic analyses, and using the Logistics Review Group HMC&M Audit Checklist during program audits. This Manual was prepared to ensure that Program Managers and other designated personnel have understandable information and specific guidance to use when they are charged with responsibility for integrating into the system acquisition process those HMC&M program elements which are consistent with mission needs, engineering suitability, and life cycle cost considerations.

While the Manual focuses primarily on HMC&M and compliance issues in the system acquisition process, the overall objective is to increase the user's perceptions of how to ensure operational readiness while reducing hazards to life, property, and the environment. Verifying that HMC&M actions are being incorporated into the entire acquisition logistics process also ensures that significant savings in manpower, facilities, and supplies will accrue to the primary Navy mission.

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INTRODUCTION TO THE GUIDANCE MANUAL

CHAPTER 1.0

"INTRODUCTION TO THE GUIDANCE MANUAL"

1.1 PURPOSE

The purpose of the "Guidance Manual For Integrating HMC&M Into System Acquisition Programs" is to provide Navy PMs and other designated personnel with guidance on where HMC&M considerations should be addressed in system acquisition programs. The Guidance Manual supports the Navy's plans for long-term HM and HW reduction by "up front" actions to reduce the amount of HM entering the system during the acquisition process.

OPNAVINST 4110.2, Hazardous Material Control and Management (HMC&M) and the Hazardous Material Afloat Program (HMAP), were implemented to require specific actions to control hazardous material (HM) and hazardous waste (HW) throughout the Navy weapon systems' life cycle, from the time of conception to ultimate disposal. HMC&M requires that HM considerations, especially those relating to environment, safety, and health issues, be included in the integrated logistics support (ILS) planning and acquisition phases. Prior to the issuance of Department of Defense (DoD) Directive 4210.15, Hazardous Material Pollution Prevention Program (HMPP), the US Navy took this programmatic action to meet DoD's stated goal of a 50% reduction in hazardous waste generation by 1992.

Navy Program Managers (PMs) must establish plans and procedures to include HMC&M compliance at the earliest possible time for system acquisitions at Phase O and prior to Milestone I. For system acquisitions status at Milestones I, II, and III, PMs must develop HMC&M plans and schedules for the full scale implementation of the Instruction. The HMC&M plan must be submitted to the Chief of Naval Operations (CNO), N-4, for review and approval.

1.2 ORGANIZATION

Organized into Chapters, the Manual offers examples of applying HMC&M considerations to meet regulatory requirements during weapon system acquisition. The relationship between HMC&M and the primary ILS elements is examined and recommendations on the inclusion of HMC&M needs throughout the acquisition system life cycle are provided.

The Manual's primary emphasis is on topics such as applying HMC&M during the acquisition logistics process, using a substitution algorithm for prioritizing the most hazardous materials (based on hazardous characteristics and volume of HW generated), performing economic analyses of pollution prevention alternatives and evaluating life cycle costs associated with feasible HMC&M techniques, and validating the inclusion of HMC&M in the Logistics Review Group (LRG) audit process.

The Manual also offers background information on Federal statutory/regulatory requirements and DoD policies that have been promulgated to prevent or reduce pollution at its source. A Glossary which integrates the most common terms relevant to the overall system acquisition process is included.

The following appendices are provided:

APPENDIX A: Glossary - which integrates the most common terms relevant to the overall system acquisition process, the substitution process, and economic analysis.

APPENDIX B: Logistics Review Group (LRG) Audit Checklist - to be used in conjunction with Chapter 3, GUIDANCE ON INTEGRATING HMC&M INTO THE ILS PROCESS, and Chapter 6, HMC&M AND THE LOGISTICS REVIEW GROUP (LRG) AUDIT PROCESS.

APPENDIX C: Description of the Substitution Process Chart Elements.

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1.3 SUMMARY

Along with a significant growth in Federal environmental regulations, there has been a concomitant increase in DoD HM/pollution prevention policies and Directives. Today, the Navy and other Military Departments are required to minimize HM acquisition throughout the weapon system life cycle, at the milestone and phase levels. Therefore, to achieve its goal of reducing generated HW by 50%, the Navy is implementing OPNAVINST 4110.2 to establish uniform policy, guidance, and requirements for life cycle control and total quality management of HM acquired and used Navy-wide.

While this Manual is not a definitive text on the ILS and Logistic Support Analysis (LSA) processes, nor an exhaustive discussion of all possible HMC&M issues, it will provide the user with a framework for ensuring that the primary HMC&M requirements are incorporated into the various phases of the acquisition logistics process.

CHAPTER 2

GENERAL POLICIES ON HMC&M IN THE ACQUISITION PROCESS

CHAPTER 2.0

"GENERAL POLICIES ON HMC&M IN THE ACQUISITION PROCESS"

2.1 INTRODUCTION

Managing, controlling, and disposing of HM and HW are some of the most pressing environmental issues of our time. In June 1990, the Assistant Secretary of Defense (Production and Logistics) stated: "Hazardous waste is the most complex environmental challenge facing the Department. It also engenders the most emotional responses from the public and regulatory agencies. I will appreciate your continued leadership in addressing this challenge."

This Chapter contains an overview of the principal policies and regulations that address environmental, safety, and health issues relevant to the military establishment. Attention is given to policies concerning controlling and managing HM within DoD in general, and within the Navy in particular. While not all-encompassing, the overview identifies specific DoD and Navy Directives and Instructions as well as Federal Regulations that mandate consideration of environmental impacts made by the acquisition, operation, and disposal of major weapon systems.

2.2 DEPARTMENT OF DEFENSE AND FEDERAL POLICIES ON HAZARDOUS MATERIALS

Throughout the system acquisition process, DoD and its Military Components have a growing responsibility to consider environmental values along with economical, technical, and logistical support factors. System testing, production, support, maintenance, operation, and disposal could all have potentially adverse environmental effects.

2.2.1 National Environmental Policy and DERA

In 1962, after author Rachel Carson created a world-wide awareness of HW dangers, there was growing concern about the scope and degree to which military operations had adversely affected the environment.

The National Environmental Policy Act (NEPA) of 1969, as amended, 42 U.S.C. 4321 et seq., mandated "that Federal agencies utilize a systematic, interdisciplinary approach which will ensure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment." DoD Directive 6050.1 of July 30, 1979, Environmental Effects in the United States of DoD Actions, updated and implemented NEPA provisions for DoD.

As the degree to which military operations had adversely affected the environment became known, there was an initiative for DoD to clean up land contaminated by past operations as well as solid and HW disposal practices.

The U. S. Army Corps of Engineers was designated as the Defense Executive Agent for cleaning up DoD sites. The Fiscal Year 1984 Defense Appropriations Act formally established this effort as the Defense Environmental Restoration Program (DERP) to be funded through a new Defense Environmental Restoration Account (DERA).

DERA consists of two major elements: 1) the Installation Restoration Program, where potential contamination at DoD installations and formerly owned properties is investigated and, as necessary, site clean ups are conducted; and 2) other Hazardous Waste Operations, through which HW reduction equipment is procured, process changes are made, and research and development of new minimizing technologies are conducted.

In response to the Resource Conservation and Recovery Act (RCRA) 1984 amendments, the Military Departments and Defense Components implemented standardized and formal hazardous waste minimization (HAZMIN) programs.

2.2.2 Handling, Transporting, and Disposing of Hazardous Materials

Federal Standard 313C, Material Safety Data, Transportation Data, And Disposal Data For Hazardous Materials Furnished To Government Activities, was issued by the Federal Supply Service, General Services Administration, to establish requirements for the preparation and submission of Material Safety Data Sheets (MSDSs) by contractors who provide HM to the Federal Government. Data obtained from MSDSs are used to provide for the safe handling, storage, use, transportation, and environmentally acceptable disposal of HM by Government activities.

DoD established the Hazardous Material Information System (HMIS) to acquire, store, and disseminate manufacturer's data on HM. The overall operation of HMIS is prescribed in DoD Instruction 6050.5 of 25 January 1978 (NOTAL). The Defense Logistics Agency manages HMIS and maintains a computerized central repository of data on all HM purchased for use within DoD. Local users receive MSDSs from vendors and suppliers who are required to supply them in accordance with FAR 52-223-3 and FED-STD-313C. MSDSs sent by local users to a service focal point are utilized to update the central data repository.

2.2.3 Hazard Communication Program HAZCOM

DoD Instruction 6050.5, DoD Hazard Communication Program, (dated January 25 1978) was reissued on October 29, 1990 to update DoD's policy for a comprehensive hazard communication program. This Instruction prescribes training for DoD personnel regarding potential health hazards, safe work practices, proper engineering controls, and availability of appropriate personal protective equipment (PPE). DoDI 6050.5 also requires DoD Components to comply with the Occupational Safety and Health Administration (OSHA) under 29 CFR 1910.120, 1910.1200, and 1900.11450, Hazard Communication Standards.

2.2.4 Hazardous Material Pollution Prevention

Elimination of HW requires elimination of waste generation. In July 1989, DoD established and implemented the Hazardous Material Pollution Prevention Program (HMPP) issued under DoD Directive 4210.15. This Directive established policy, assigned responsibilities, and prescribed procedures for preventing HM pollution. Applied across all levels of DoD, the Directive established that HM will be selected, used, and managed over the entire life cycle so that DoD incurs the lowest required cost to protect human health and the environment. Where HM use cannot be avoided, users will follow regulations governing its use and management as required by DoD issuances. In general, DoDD 4210.15 requires that directives, regulations, manuals, specifications, and other documents that provide DoD's operating procedures will incorporate guidance on HM issues.

All DoD Components must develop and maintain an HMPP Plan which contains, at a minimum, specific elements such as: reporting mechanisms; information exchange on pollution prevention; cooperation with public agencies involved in waste reduction, pollution prevention, or waste minimization; participation of critical functional staff offices such as systems acquisition, design, specification proponents, etc.; and a process for analyzing existing operations or processes for waste minimization potential.

DoD's HMPP Directive is aimed at bringing the Military Departments and other DoD Components into compliance with statutory codes and regulatory requirements including, but not limited to, RCRA, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and OSHA's HAZCOM Standard.

The Directive emphasizes pollution prevention rather than "end-of-the-pipe" solutions. Where HM use cannot be avoided, DoD personnel must apply management practices that avoid harm to human health and the environment. Operational areas affected by HM use include: budget and fiscal planning, research and development, weapons systems acquisition and maintenance, performance specifications and standards, industrial processes, procurement policy, contracting provisions, safety and occupational health, transportation, supply, warehousing, distribution, recycling, disposal, etc.

Other factors identified in DoDD 4210.15 which influence HM use or effects include:

- Functional guidance--such as DoD guidance promulgated in issuances and functional guidance regarding the risk of future liability from HW disposal.

- Alternatives--ways of reducing the adverse effects of HM such as: substituting less hazardous materials; redesigning a component to eliminate the HM use; modifying processes or procedures that presently require HM; extending shelf life of a material; and, restricting users.

- Intangible factors--including the quality of defense and the quality of the environment which may be influenced by public emotion and potential legislation.

- Life cycle factors--effects of HM use when a system is first envisioned as well as later operation and maintenance; new HM use by a DoD Component; and, when HM is already in use, viewing its association with the material by what results in terms of human health and environmental problems.

- Cost factors--involving expenses and cost avoidance associated with HM and the effects future environmental problems may have on future costs and defense performance.

- Economic analysis--evaluating the costs associated with HM use and potential alternatives to arrive at an informed judgement.

The HMPP Directive is a strong addition to an extensive amount of waste minimization work already underway with the Military Departments and other DoD Components.

2.2.5 Defense Acquisition Policy

DoD subsequently revised its systems acquisition policy and reissued DoD Directive 5000.1, Defense Acquisition. This Directive established a more disciplined approach to integrating the products of DoD's requirements generation, acquisition management and planning, programming, and budgeting systems. DoD Instruction 5000.2, Defense Acquisition Management Policies and Procedures, was reissued to implement the policies and procedures of DoDD 5000.1.

DoDI 5000.2, Part 6, Section I "System Safety, Health Hazards, and Environmental Impact," established the basis for effectively integrating system safety, health hazard, and environmental considerations into the systems engineering process. Section I also ensured that scientific and engineering principles will be applied during design and development to reduce hazards associated with a system's operational support. Thus, the goal of DoDI 5000.2 is designing the safest possible systems consistent with mission requirements and cost-effectiveness.

Under Part 6, Section I, a system safety program that identifies, evaluates, and eliminates or controls system hazards must be established through the tailored application of selected Military Standards (MIL-STDs). MIL-STDs such as MIL-STD-882, System Safety Program Requirements, can be adapted to specific program characteristics. In addition, system safety engineering programs are to be designed to work in harmony with other comprehensive DoD product improvement programs (e.g., manpower, personnel, and training programs; logistics support analysis programs; reliability and maintainability programs, and software quality assurance programs). Policy objectives under Part 6, Section I include:

- System safety and health hazard objectives will be established early in a program and used in the decision process.

- Emphasis will be on reducing HM use rather than managing the HW created.

- Systems will be analyzed for environmental impacts in accordance with NEPA regulations and Executive Order 12114, "Environmental Effects Abroad of Major Federal Action."

- Risks associated with an identified hazard will be formally documented using MIL-STD-882 and criteria for defining and categorizing "high" and "serious" risks.

DoD Manual 5000.2-M, Defense Acquisition Management and Documentation and Reports, issued under the authority of DoDI 5000.2, contains procedures and formats for preparing milestone documentation, periodic in-phase status reports, and statutory certifications.

As this overview demonstrates, there are numerous DoD policy documents, supported by relevant MIL-STDs, which mandate that constituent organizations comply with regulations, treaties, and applicable Federal, State and local environmental laws in the United States and its territories. Because failure to address NEPA and other regulatory requirements may cause unnecessary delays in acquiring new weapons and other systems, each managing activity must give environmental concerns the same emphasis as managing the technical, financial, and logistics aspects of a system's life cycle.

2.3 U. S. NAVY POLICIES AND INSTRUCTIONS

National defense and environmental protection are compatible goals. However, environmental regulations have increased significantly in recent years and are in a continuous state of change. Navy programs needed to meet both current and projected environmental compliance initiatives are expected to grow significantly.

2.3.1 OPNAVINST 5090.1A

The Navy's mission requires operations in land, sea, and air environments. To ensure that its systems acquisition and logistics support actions (which may have significant environmental impacts) are accomplished in accordance with the letter and spirit of NEPA, the Navy issued OPNAVINST 5090.1A, Environmental And Natural Resources Program Manual. This Manual contains the policy and procedures for implementing NEPA, the basic national charter for protecting the environment.

OPNAVINST 5090.1A assigns responsibilities for managing Navy programs including compliance with related laws and regulations, environmental protection, natural resources conservation, preservation of cultural and historic resources, and pollution prevention. Under this Instruction, the methods for eliminating or minimizing pollutants are to be identified and, where possible, incorporated at the earliest stages of planning, design, and procurement of facilities, weapon systems, equipment, and materials.

2.3.2 Emergency Planning and Community Right-To-Know Act

Navy policy for responding to the Emergency Planning and Community Right-To-Know Act of 1986 (EPCRA) (also known as Title III of the Superfund Amendments and Reauthorization Act) is also addressed in OPNAVINST 5090.1A cited above. EPCRA established a series of reporting requirements for facilities handling HM. Although Federal facilities are not specifically covered by the legislation, the Navy policy is one of voluntary compliance in four major areas: community emergency planning, emergency release notification, hazardous chemical reporting, and toxic chemical release reporting.

2.3.3 Hazardous Material Control and Management

On June 20, 1989, concomitant with the DoD policies and standards referenced earlier, the Navy issued OPNAVINST 4110.2, Hazardous Material Control and Management (HMC&M), to establish uniform policy, guidance, and requirements for the life cycle control and total quality management (TQM) of HM acquired and used by the Navy. HMC&M must be addressed from concept formulation of a new or modified Navy system through the research, development, acquisition, production, operation, and final disposition phases.

The Navy goal, using 1987 as the base year, is to reduce generated HW by 50 percent no later than the end of calendar year 1992. Such a goal is attainable by improving HM life cycle management. In addition, minimization efforts may require changes in acquisition policies, improvements in shelf-life programs, increased awareness through improved training programs and information exchange, substitution of less hazardous or non-hazardous materials for extremely hazardous materials, and changes in applicable units-of-issue for HM.

From a TQM perspective, HMC&M requires clearly defined actions from the top management level to the lowest operating level within each phase of systems, components, materials, or parts acquisition. Navy policy also requires that procedures be developed to clearly identify and document HM use, HW minimization efforts, environmental impacts, safety and health issues, and disposal guidance. Most importantly, HM issues, particularly those relating to the environment, safety, and health, are to be included in the earliest stages of ILS planning and acquisitions phases.

Through Navy Directives, primarily OPNAVINST 4110.2, specific HMC&M program responsibilities are assigned to commanders of systems commands and fleet commanders-in-chief, with special assignments given to commanders of Navy facilities concerned with systems development, system acquisition and research, and education and training. The following excerpts from OPNAVINST 4110.2 delineate the primary HMC&M actions required of key Navy personnel concerned with the acquisition of systems, components, materials, or parts.

The Chief of Naval Operations (CNO) and the Deputy Chief of Naval Operations (DCNO) (Logistics) (N-45)

maintain policy and direct, coordinate, monitor, evaluate, and assure preparation of appropriate reports concerning the Navy HMC&M program activities. They must incorporate necessary HM/HW requirements, audits, and certifications into ILS and LRG activities, so that HMC&M policies and procedures are met.

Platform Sponsors (N-2, N-3, N-5) assure that HMC&M requirements are designed into new fleet platforms, systems, and facilities and assist N-4 in planning and overseeing the Navy HMC&M Program, and advising N-45 and the CNO on progress toward established goals.

The DCNO (Navy Program Planning (N-8) issues guidance for the identification and submission of HM/HW management program costs/savings and provides fiscal incentives to control and manage HM and reduce quantities of excess HM/HW in the annual budget call.

The Office of the Naval Inspector General (NIG) makes HMC&M a "CNO special interest item" for 5 years or until a Navy-wide 50 percent reduction in HW weight is reached.

The Director, Naval Nuclear Propulsion, pursuant to the provisions of Executive Order 12344, as codified in 42 US 7158, must accept responsibility for all technical aspects of the research, development, design, procurement, specification, construction, inspection, installation, certification, testing, overhaul, refueling, operating practices and procedures, maintenance, supply support, and ultimate disposition of naval nuclear propulsion plants.

The Chief of Naval Research (CNR) must take responsibility for the Navy's basic scientific research and related exploratory and advanced development programs, including the issuance of and compliance with codes, standards, and regulations regarding HMC&M.

The Fleet Commanders-in-Chief and Type Commanders ensure compliance with HM/HW requirements for forces afloat, including making changes to the ship's hazardous material lists (SHML), recommending less hazardous substitutes, funding Navy shore activities incurred in handling, storing, and disposing of HM, and promoting adherence to established procedures in Navy ports for marking containers and preparing offloading documents.

The Commander, Naval Supply Systems Command (NAVSUPSYSCOM) serves as the overall PM for the supply aspects of the Navy HMC&M Program, with responsibility for developing and maintaining a Navy-wide HM authorized use list (AUL). Other responsibilities include: reviewing shelf-life policies, material specifications and standards; ensuring receipt of MSDS information; ensuring appropriate Federal and DoD labeling and marking regulations; establishing logistics and supply policies/procedures; and maintaining Navy-wide lists of authorized HM for ashore and afloat units by categories and classes of activities.

The Commander, Naval Facilities Engineering Command(NAVFACENGCOM) must develop and update design criteria, siting instructions, and regulatory requirements for long- and short- term

storage of HM/HW. Other areas within his purview include: ensuring that hazard analyses are performed in accordance with MIL-STD-882B and 5100.24A; ensuring that technical assistance is provided on HM in the workplace and HW treatment; and assisting in preparing pollution abatement programs and NAVOSH hazard abatement programs. The Commander must also assist in emergency responses, HW cleanups, and monitoring construction contracts to guarantee that a HM inventory and MSDSs are provided for Government work sites.

The Commander, Bureau of Medicine must provide workplace hazard evaluations, health risk assessments, and related technical information; provide commanders and commanding officers with technical assistance on HM use; and assist shore activities in developing AULs. He must also include HW in health hazard assessments and appraisals during occupational health and industrial hygiene surveillance activities; provide Systems Commands (SYSCOMS) with guidance on permissible exposure limits in the workplace; and evaluate toxicological research for new systems or for Navy-unique or Navy-manufactured HM.

The Chief, Naval Education and Training (CNET) must incorporate HMC&M into the Navy Training Plan; provide specialized HMC&M training including spill control, HM/HW handling and disposal; integrate HMC&M principles and procedures into the Navy Supply Corps Officers School and the Civil Engineer Corps Officers School; acquire and distribute audio-visual materials for HMC&M training; and serve as a central source of information on HMC&M training courses.

The Commanders of Echelon II Major Commands, System Commands, and Designated Program Managers must assist NAVSUPSYSCOM in developing and maintaining a centralized list of authorized HM; coordinate with NAVSUPSYSCOM the incorporation of MSDSs into the HMIS for each HM on the AUL; validate or modify HM units of issue to conform to HMC&M policies; and develop and implement HM substitution programs. Other responsibilities involve actions to: reduce and/or minimize entry of HM into the supply system; ensure HAZCOM programs are implemented; establish adequate HMC&M funding programs for facilities and operations; submit HMC&M plans and provide guidance on program priorities; and ensure elements of OPNAVINST 4110.2 are included in negotiating or operating Government-owned contractor-operated (GOCO) facilities.

The Area Coordinators and Regional Environmental Coordinators must promote HMC&M among regional commands and activities and compliance with NAVOSH and environmental programs as key aspects of HMC&M.

The Commanders and Commanding Officers of Shore Activities must develop written, responsive HMC&M plans that comply with OPNAVINST 4110.2 and all Federal, State, and local laws and regulations applicable to HM/HW. They must also establish appropriate HM labeling procedures; develop an AUL and distribute MSDSs for each HM product or components produced or manufactured at shore activities or laboratories; and control

and safeguard HM labeling, collection, pickup, transportation, and disposal. Other responsibilities under their cognizance include actions to; limit open market purchases; establish Inter-Service Support Agreements on HMC&M requirements; resolve budgeting deficiencies in HMC&M budgeting and allocation of resources; and, report all HMC&M incidents which are a risk to the environment, safety, and health of assigned personnel.

The Commanders/Commanding Officers of Navy Activities in Foreign Countries must comply with applicable HM/HW requirements of host nations, if more restrictive that U. S. regulations; conform to U.S., OSHA, and the Environmental Protection Agency (EPA) laws and regulations, when host requirements are less stringent; develop an HMC&M Plan, an AUL, and provide copies of surveys and HW management plans to environmental coordinators, NAVFACENGCOM Engineering Field Divisions (EFDs) and the Naval Energy and Environmental Support Activity; and acquire technical assistance, as needed, from medical commands and NAVFAC EFDs for HAZMIN and HW disposal issues.

In addition to the responsibilities delineated above, the acquisition PMs, assisted by designated LEMs, must perform specific tasks to meet the minimum requirements for incorporating HMC&M into the acquisition logistics process. These responsibilities include, but are not limited to:

- Reviewing system HM/HW characteristics.
- Developing HMC&M implementation plans and milestones.
- Incorporating HMC&M into the Integrated Logistics Support Plan (ILSP) and LSA.
- Completing HMC&M decision documents (e.g., risk and hazard analyses, economic analyses).
- Planning for LRG audits.
- Ensuring HMC&M is incorporated in contract Statements of Work (SOWs) and Source Evaluations.
- Identifying any required research and development regarding hazards.

An effort is presently underway to produce a new Secretary of the Navy (SECNAV) Instruction entitled: "Integrated Logistics Support (ILS) in the Acquisition Process," which will include specific guidance for HMC&M aspects of ILS.

CHAPTER 3

GUIDANCE ON INTEGRATING HMC&M INTO THE ILS PROCESS

CHAPTER 3.0

"GUIDANCE ON INCORPORATING HMC&M INTO THE ILS PROCESS"

3.1 INTRODUCTION

Navy policy requires that plans, procedures, and documentation be developed which clearly identify HM, HW minimization efforts, environmental, safety, and health issues, and disposal guidance, in accordance with DoDD 4210.15, OPNAVINST 4110.2, and DoDI 5000.2 PART 6, Section I. Compliance with environmental requirements is to be accomplished through "up front control" of HM in acquisition, procurement, supply, and manufacturing rather than "after the fact" control and disposal efforts.

3.2 PURPOSE

This Chapter provides guidance on incorporating HMC&M considerations into the overall acquisition logistics process. The key role that PMs play in ensuring that OPNAVINST 4110.2 requirements and other applicable Directives and Instructions are addressed throughout the system acquisition life cycle is discussed.

To ensure a more comprehensive understanding of HMC&M issues in systems acquisitions, the Chapter provides: an overview of general HMC&M requirements; the PM's role in HMC&M planning and milestone decisions; a discussion of environmental impact, system safety, and health hazard requirements and HMC&M; acquisition phases and milestones and related HMC&M issue items; and, the incorporation of HMC&M issue items into the primary ILS program elements.

3.3 OVERVIEW OF HMC&M REQUIREMENTS

The Navy developed and implemented OPNAVINST 4110.2 (HMC&M) prior to the issuance of DoDD 4210.15. HMC&M requires that HM considerations, especially those relating to the environment, safety, and health, be included in the earliest stages of ILS planning and acquisition phases.

PMs must include HMC&M compliance plans at the earliest possible time for system acquisitions at Phase O and prior to Milestone I. For system acquisitions status at Milestones I, II, and III, ILS PMs must develop HMC&M plans and schedules for the full scale implementation of the Instruction. The HMC&M plan must be submitted to the CNO (N-4) for review and approval.

For existing systems and equipment, the HMC&M plan requirements were in effect 36 months from the issue date of OPNAVINST 4110.2. All Echelon 2 commanders and commanders-in-chief must implement plans, schedules and actions for systems under their cognizance involving HM. HMC&M plans must include a centralized list of authorized HM or the approved, less hazardous substitutes. All Echelon 2 commanders are to assist

NAVSUPSYSCOM in developing and maintaining an AUL. They must ensure that MSDSs are obtained and incorporated into the HMIS for each HM on the Navywide AUL.

Echelon 2 commanders must also maintain programs that specify the least hazardous, technically acceptable materials throughout the procurement process, including validating or modifying HM units of issues to conform to HMC&M policies. If the system is for shipboard use, the audit process should ensure that similar action is taken with regard to the SHML.

3.3.1 The Program Manager's Role In HMC&M Planning And Milestone Decisions

The Navy PM plays a very important role in ensuring that HMC&M is incorporated into the acquisition logistics process. Key activities under his cognizance include:

- Reviewing system HM/HW characteristics.
- Developing implementation plans and milestones to incorporate HMC&M into the ILSP and the LSA.
- Completing HMC&M decision documents (e.g., risk and hazard analyses, economic analyses).
- Planning for LRG audits.
- Incorporating HMC&M into contract SOWs and source evaluations.
- Identifying required research and development regarding hazards.

At the system needs determination point, and prior to Milestone I, the PM should make assessments concerning lessons learned from similar systems about environmental, safety, and health problems, and the identification of potential pollution and HM problems to be considered during Phase 0 and later phases.

3.3.2 Overview Of Environmental Impact, System Safety, and Health Hazard Requirements

DoD systems must be designed, developed, tested, fielded, and disposed of in compliance with all applicable environmental protection laws, treaties, and Federal, State, and local environmental laws (e.g., the Emergency Planning and Community Right-To-Know Act of 1986).

As specified in DoDI 5000.2, PART 6, Section I, initial environmental analysis and planning begins at the earliest time in the life cycle. All potential environmental effects must be identified and integrated with both economic and technical analyses. During Phase O, Concept Exploration and Definition, potential environmental effects must be assessed and integrated into each alternative.

System safety and health hazard objectives, which are used to guide the decision process, must also be established early. Through the tailored application of MIL-STD-882, System Safety Program Requirements, in accordance with PART 6, SECTION I, a system safety program that identifies, evaluates, and eliminates or controls system hazards must be established.

The disciplines of system safety, human factors engineering, and health hazard analyses are also important aspects that should be used to avoid or minimize HM use. Where HM use cannot be avoided, procedures to identify, track, store, handle, and dispose of it must be developed and implemented. Further, the total system, including hardware, software, testing, manufacturing and support must be evaluated for known or potential hazards during the entire life cycle.

Preliminary Hazard Analysis– Hazard identification should be performed primarily through a tailored application of Task 202, MIL-STD-882, "Preliminary Hazard Analysis," used in conjunction with MIL-STD-1388. The performance of a PHA should be documented during Phase O and prior to Milestone I. The LEM should coordinate requirements with the System Safety Office to ensure agreement with HMC&M requirements. Attention should be given to the coordination requirements of paragraph 4.1.1, MIL-STD-1388-1A.

Suitably tailored tasks of MIL-STD-882 should be included in SOWs and discussed in the LSA and ILSP. The appropriate Data Item Descriptions (DIDs) should be specified in the SOW and its Contract Data Requirements List (CDRL) for each of these tasks. (Section 3.6 presented later describes the phased application of MIL-STD-1388-1A and 882B Tasks). Prior to Milestone I, the PM must take action to incorporate potential environmental hazards and impacts into each system alternative and to address initial HMC&M requirements.

The Programmatic Environmental Analysis (PEA) begins immediately after Milestone I. The PEA describes potential environmental impacts of each alternative throughout the system life cycle, potential mitigation of adverse impacts, and how the mitigation would affect scheduling, siting alternatives, and program costs. PEAs, which occur regardless of program class, are updated after each succeeding milestone decision point. The Integrated Program Summary (IPS) contains a summary of PEA results, and if in the form of an Environmental Impact Statement (EIS), a Record of Decision is prepared which becomes a public document (unless classified).

During the audit process, available documentation will be checked to ensure that a PEA has been performed (regardless of program classification) for the proposed acquisition. Unless there is a "Finding of No Significant Impact", the auditor will validate that a PEA has been completed prior to the next milestone decision point and that it has been coordinated and integrated with other plans and analyses.

Special attention will be given to OPNAVINST 5100.24A, Section 6 (Navy System Safety Program), which contains mandatory requirements for identifying, evaluating, and eliminating hazards prior to systems production, construction, and deployment (all acquisition category (ACAT) I and II programs). (More detailed discussion of relevant MIL-STDs is presented later in this Chapter.)

3.4 HMC&M ISSUES BY ACQUISITION PHASE/MILESTONE

HMC&M issues must be incorporated into each major ILS program area at various acquisition phases (shown in Figure 3-1 --source: DoDI 5000.2, Part 11, Section A). The HMC&M issues addressed here are not all-inclusive because each new system will have unique characteristics and mission requirements.

3.4.1 Determination of Mission Needs

Taking place prior to Milestone 0, mission needs determination (not a formal "phase") marks the commencement of the acquisition process. Mission needs which can be met by non-material solutions (i.e., changes in policy or training) are eliminated. Mission needs which require a material solution continue on to a Milestone 0 review. Prior to Milestone 0, the following HMC&M issues should be assessed and incorporated into the Mission Need Statement (MNS) and/or Operational Requirements Document (ORD), as required:

- **Lessons learned about environmental, safety, and health problems from similar systems, both military and civilian.** (While identifying potential problem areas, the MNS authors are setting the stage for informed trade-off decisions throughout the acquisition process.) The absence of previous lessons learned should alert the MNS authors that HMC&M issues will require even closer scrutiny.

- **Identification of potential pollution and HM problems which require consideration during Phase 0 and later phases.** These problems may facilitate trade-off decisions by Navy and contractor personnel and approval of high risk, mission critical materials.

- **MNS authors should thoroughly review the relevant elements of DoDI 5000.2 with special emphasis given to preliminary identification, evaluation, and elimination of hazards.**

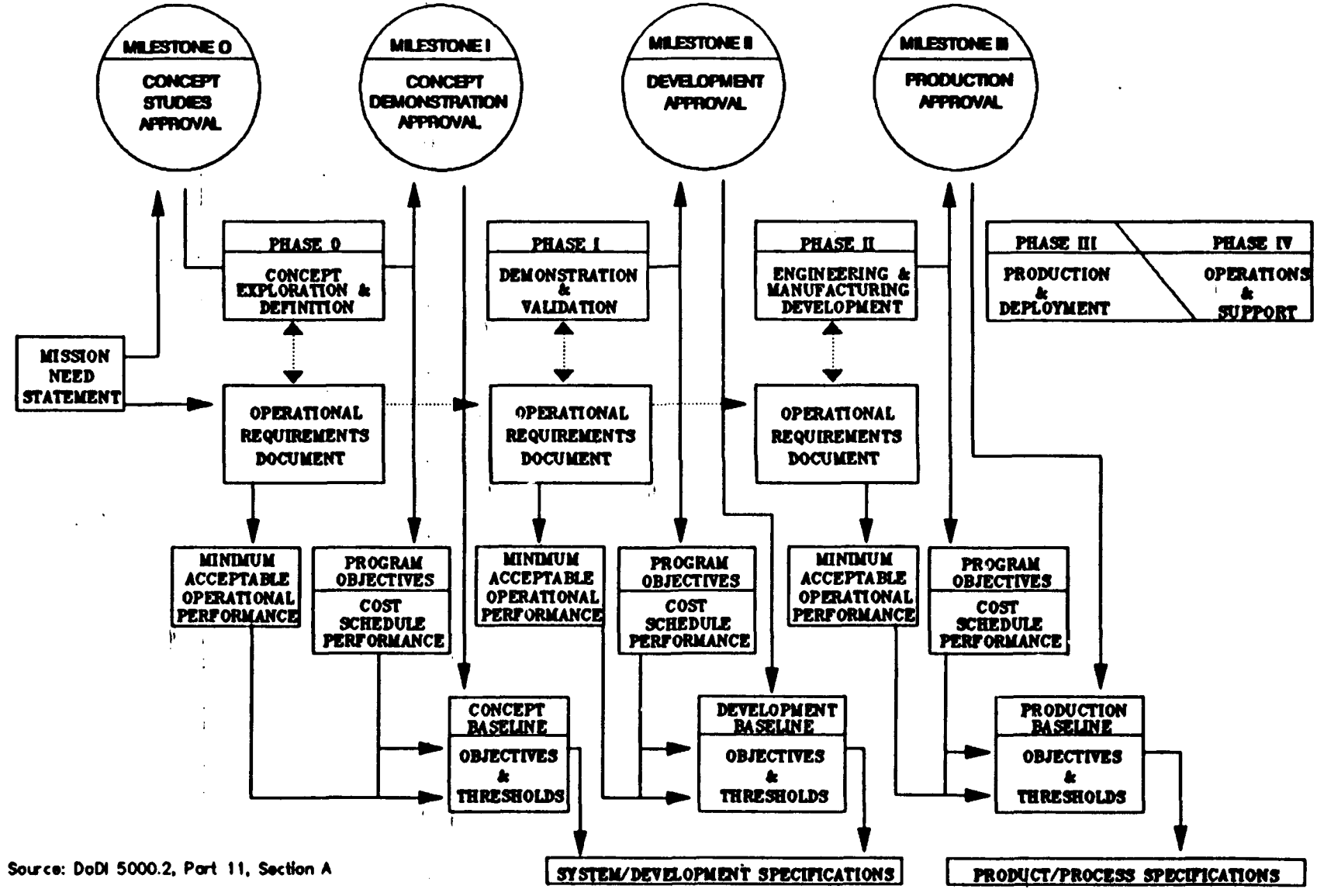
3.4.2 Acquisition Phase 0, Concept Exploration and Definition

During Phase O, when initial testing is performed to determine which concept meets mission needs and when system alternatives are explored, it is critical to address HMC&M issues such as:

- **Identifying, selecting, and approving the system's HM and resulting HW characteristics.** During Phase O, developing milestone charts and schedules for the PHA and SOW requirements are of primary importance. Each concept under study may need its own PHA and unique HMC&M SOW.

- **Planning for PEAs and EISs.** Initial planning for PEAs and EISs should be in conjunction with developing the HM identification, selection, and approval process.

FIGURE 3 - 1
ACQUISITION MILESTONES AND PHASES



Source: DoDI 5000.2, Part 11, Section A

- **Incorporating HMC&M requirements into the ILSP, its supporting LSA, and tailoring the environmental, safety, and related needs to MIL-STD-1388-1A and MIL-STD-882B tasks.** Because HMC&M is a certification-dependent issue within the acquisition process, the ILSP and LSA must contain the basic HMC&M requirements.

- **Identifying, planning, and allocating resources for HM research, development, test and evaluation (RDT&E) needs.** In systems utilizing new technology, adequate planning for RDT&E will be critical to selecting the least hazardous material.

- **Including HMC&M in life cycle cost (LCC) estimates and analyses.** HMC&M issues must be incorporated into LCC estimates and analyses for each concept, including direct costs (such as material, additional PPE, and disposal costs) and indirect costs (such as environmental liability, handling, storage, etc.).

- **Establishing procedures for analyzing, documenting, and accepting serious or high risk hazards.** DoDI 5000.2, PART 6, SECTION I, mandates that all serious and high risk HMs proposed must be approved at the "Three Star Level."

- **Incorporating HMC&M requirements into contractor SOWs and appropriate Data Item Descriptions (DIDs).** Failure to do so could result in the system not achieving milestone certification. Appropriate tasks of MIL-STD-882 and MIL-STD-1388 must be incorporated into contractor documents.

- **Including HMC&M in all design reviews, design objectives, supportability and test evaluations.** HMC&M should be a topic at all contractor project reviews to ensure that HMC&M issues are being addressed.

- **Developing HMC&M exit criteria to apply to each succeeding Milestone.** The PM must emphasize the existence and approval of serious or high risk HM/HW hazards that cannot be eliminated or mitigated.

- **Including system safety, health hazards, and environmental risks in the IPS.** Because HMC&M is a certification-dependent requirement (and a requirement of DoDI 5000.2, PART 6, SECTION I), the PM should ensure that HMC&M issues are addressed in the IPS.

3.4.3 Acquisition Phase I, Demonstration and Validation

Expanding on the concept selected in Phase O, the Phase I concept performance, cost, acquisition schedule, and supportability issues and plans are refined in preparation for full scale development. The PM must ensure that the following program actions are taken to ensure continuing implementation of HMC&M requirements:

- **HMC&M requirement(s) are incorporated into the ILSP and LSA.** Decision documents such as risk and hazard analysis, LCC analysis, etc. should be planned and well underway.

- **HM considerations are incorporated into the trade-off analysis.** HM trade-off analyses should be well documented, especially when the more hazardous material was selected.

- **Facilities design planning.** Plans for new facilities or changes to existing facilities for HM storage should be reviewed to determine whether specialized hazard control or waste disposal requirements associated with approved HM use are needed.

- **Specialized training requirements.** Special training due to approved HM/HW should be incorporated into training plans.

- **PHA and other hazard analyses completed before the Milestone.** Where hazards cannot be eliminated and high or serious risks must be accepted, plans for necessary approvals should be in place.

- **Programmatic Environmental Analysis.** The PEA should be updated and included in the IPS.

- **HMC&M requirements are included in Request for Proposals (RFPs), SOWs, source selection evaluation criteria, and other contract provisions.** The PM must ensure that appropriate tailored tasks of MIL-STD-882 and MIL-STD-1388 are incorporated into contractor documents.

- **HMC&M items are included in the Logistics Support Analysis Record (LSAR) and DoD 5000.2-M reports.**

- **Authorized Use List.** Ensure that procedures are in place for review and establishment of the system AUL.

3.4.4 Acquisition Phase II, Engineering and Manufacturing Development

This Phase involves extensive engineering efforts. A limited quantity of system components may be ordered to verify production quality and to provide for developmental and operational testing. HMC&M requirements identified during prior milestones should be carefully reviewed with attention given to:

- **Contract requirements.** Ensure that ILSP elements and thresholds are being met. Major system contractor and subcontractor SOWs should include specific, HMC&M-tailored requirements.

- **Training requirements.** Identify additional training requirements for HM handling and HW disposal.

- **Authorized Use List.** Ensure that procedures are in place for HM AUL establishment and review.

- **Controls and disposal systems.** Ensure that controls and disposal systems for previously approved HM are completed prior to system operation.

- **PPE and disaster response.** Identify requirements for PPE and disaster response associated with approved HM and include in the ILSP supply and support equipment elements.

- **Precautionary and warning information.** Ensure that precautionary and warning information for manuals, training documents, technical orders, and other instructional materials associated with the system are being planned either by contractor(s) or in-house.

- **Updated PEA.** Confirm that the PEA has been updated.

- **Exit criteria.** Ensure compliance with all exit criteria relating to HM and system hazards.

- **Permits.** Identify and obtain necessary permits relating to HM and/or environmental hazards.

- **IPS.** Ensure that system safety, health hazards, and environmental risks are included in the IPS.

3.4.5 Acquisition Phase III, Production and Deployment

Phase III (full production of a new system) represents the major expenditure of program funds and the obligation of future operational and maintenance funds. To validate compliance by contractors and Navy organizations, the PM must oversee post-production HMC&M management. Changes needed during production and deployment must be implemented.

3.4.6 Acquisition Phase IV, Operations and Support

This Phase (when the system is fielded and operational) represents the end of the acquisition effort. However, logistical support and maintenance, which continue throughout the system's operational life, will require inclusion of HMC&M requirements.

3.5 HMC&M ISSUES IN ILS PROGRAMS AND PLANS

Specific plans are required to document ILS performance capability thresholds required by program sponsors and to describe how the ILS program will attain these thresholds. This section provides guidance on incorporating HMC&M requirements into major acquisition documents which need significant input from the ILS program. The recommended document format for the acquisition documents can be found in DoD 5000.2-M. Where appropriate, cited "paragraphs" in the remainder of this Section refer to the DoD format paragraph for the document under discussion.

3.5.1 Mission Need Statement (MNS)

The MNS, requiring limited ILS input, defines the projected needs in very broad operational terms. HMC&M issues addressed will have far reaching effects on the proposed system. The MNS format (DoD 5000.2-M, PART 2-1) defines the five general areas to be discussed within the MNS. Paragraphs 3, 4, and 5 described below are relevant to HMC&M:

- **Non-material Alternatives.** (DoD 5000.2-M, PART 2-1, paragraph 3). The MNS author explains why changes to doctrine, operational concepts, tactics, organization, and training are not adequate to meet the new threat. The PM should note in the MNS any HMC&M issues which invalidate a nonmaterial solution.

Such issues may be the increased HM disposal costs or the increased health risk to personnel due to an escalation in the maintenance requirements of an older system.

- **Potential Material Alternatives.** (DoD 5000.2-M, PART 2-1, paragraph 4). The MNS's primary purpose is to discuss potential material alternatives. The PM should address HMC&M issues only when the potential material solution is itself a HMC&M-related item (e.g., the purchase of a new battery pack with fewer environmental hazards).

- **Constraints.** (DoD 5000.2-M, PART 2-1, paragraph 5). The constraints section, which sets the limits and boundaries for system development, must include HMC&M requirements.

3.5.2 Operational Requirements Document (ORD)

The ORD contains performance objectives and related operational parameters for the system concept. Generally initiated during Phase 0, the ORD precedes or is included with the MNS. HMC&M issue items discussed in the MNS section must be included in the ORD. The ORD is revised and updated at every milestone, with very broad requirements at Phase 0 and very specific ones in Phase IV. General HMC&M issue items included in the initial ORD, which are revised to be more specific as the new system acquisition progresses, include:

- **Capabilities Required.** (DoD 5000.2-M, PART 3-12, paragraph 4). When developing contract specifications at each acquisition phase, the PM must ensure that HMC&M issue items are incorporated into each general area of the ORD Capabilities Required section.

- **Logistics and Readiness.** (DoD 5000.2-M, PART 3-1, Paragraph 4.b). This subsection must include HMC&M issue items related to operational availability, maintenance, manpower requirements, and skill level. It must also address environmental impacts of system production and use, including use and maintenance during training exercises.

- **Critical System Characteristics.** (DoD 5000.2-M, PART 3-1, paragraph 4.b.). System safety parameters are those HMC&M issue items that will ensure the system presents the lowest possible risk to the users' personnel and property and will be engineered into the new system from initial concept.

- **ILS.** (DoD 5000.2-M, PART 3, paragraph 5). The ILS section states the ILSP objectives and goals covering the same general areas, e.g., maintenance planning, support equipment, facilities, etc.
(Note: HMC&M considerations for the individual ILSP elements are covered later in Section 3.5 of this Chapter).

3.5.3 Manpower Estimate Report

The Manpower Estimate Report, a requirements document, provides detailed information on the total number of personnel (military, civilian, and contractor)

which will be required to operate, maintain, support, and train for the program upon full operational deployment. Because this information provides estimates on overall system affordability, the PM must ensure that consideration is given to HMC&M factors such as additional maintenance manpower requirements due to reduced efficiency when wearing PPE and special training requirements for HW workers.

Specialized manpower needs may include authorizations for HM/HW handlers and operators; augmentation of support resources at operational bases (e.g., HM warehouse handlers, etc.); impacts on existing resources that support organizations (such as Naval Facilities Engineering Command) because of additional hazard requirements associated with environmental compliance; and unique and specialized facilities for pollution prevention. Emphasis should be given to resources, hazard communications, emergency procedures, HW, and hazards control.

3.5.4 Integrated Program Summary (IPS)

The IPS with its annexes, provides a succinct, integrated picture of the program's status for use by the milestone decision authority, supporting staff, and review forums. The IPS is a documentation requirement under DoDI 5000.2, PART 11, SECTION C, for acquisition categories (ACATS) I through IV and Milestones I through IV.

A part of risk assessment and environmental analysis, the IPS assesses system safety, health hazards, and environmental risks that cannot be corrected or mitigated through system design changes or new technology. It is used to identify what residual hazards and impacts must be accepted by formal decision.

Based on an assessment of predecessor or comparable systems and new technologies, the IPS should identify high risk areas in human system integration that have been targeted for mitigation to improve system performance, reduce manpower, personnel, and training requirements, and reduce or eliminate critical human performance errors. Like the ORD, the IPS is updated and revised during each Phase, prior to the milestone review. The following IPS paragraphs illustrate HMC&M issue items which should be incorporated/revised as a new system acquisition progresses (DoD 5000.2-M, PART 4-A):

- **Program Execution Status.** (DoD 5000.2-M, PART 4-A, paragraph 1). An executive summary of the system acquisition process, this is one of the first documents to be reviewed by LRG auditors. The absence of HMC&M issue items should alert the PM to verify HMC&M program status. HMC&M issue items should be reflected at a minimum in paragraphs 1.a.(1), 1.a.(4), and, depending on milestone status, paragraphs 1.b.-e.

- Paragraph 1.a.(1). (DoD 5000.2-M, PART 4-A, paragraph 1.a.(1)). This paragraph describes how exit criteria for this phase were met. For HMC&M issue items, it may be necessary to characterize the exit criteria by lines of effort.

- **Paragraph 1.a.(4).** (DoD 5000.2-M, PART 4-A, paragraph 1.a.(4)). This paragraph summarizes major cost, schedule, and performance trade-offs made and outlines plans for trade-off decisions in the next phase. HMC&M trade-off decisions should include information on the cost and performance effect of the related trade-off.

- **Paragraphs 1.b.-e.** (DoD 5000.2-M, PART 4-A, paragraph 1.b.-e). These four paragraphs give information on progress made during the preceding phase (paragraph b. for system at Milestone I; paragraph c. at Milestone II, etc.). At each milestone, the progress made under the HMC&M program is identified and the rationale for specific decisions given.

- **Alternatives Assessed and Results.** (DoD 5000.2-M, PART 4-A, paragraph 3). This ILS paragraph includes an assessment of alternatives, the rationale for their acceptance or rejection, and HMC&M issues related to the assessment. If a lower HMC&M-related risk was rejected, the rationale for accepting the higher HMC&M risk should be well documented.

- **Most Promising Alternative and Rationale.** (DoD 5000.2-M, PART 4-A, paragraph 4). This section provides cost, schedule, and performance assessments for the most promising alternative. HMC&M issue items and trade-offs should be discussed in relation to the MNS, ORD and other alternatives. The LCC estimate summary (Annex B of PART 4-A) should include HW disposal cost, PPE cost, additional training cost, etc.

- **Acquisition Strategy.** (DoD 5000.2-M, PART 4-A, paragraph 5). This section (Annex C of PART 4-A) provides detailed information on the overall acquisition plan. Paragraph 2, Annex C, which details the Government and contractor responsibilities and inclusion of HMC&M requirements in all SOWs, is especially important.

- **Cost Drivers and Major Trade-offs.** (DoD 5000.2-M, PART 4-A, paragraph 6). This section provides major trade-offs and cost drivers for the next phase; such comprehensive HMC&M-related information will allow the milestone decision authority to assess trade-off potential.

- **Risk Assessment and Plans to Reduce Risk.** (DoD 5000.2-M, PART 4-A, paragraph 7). Supported by Annexes D and E, plans to reduce all known and potential risk must be summarized here by the PM. HMC&M-related risks include assumed liability from personnel exposure during handling of highly toxic materials, or limited production ability for a less hazardous (substitute) material. Annex E highlights environmental issues/risks.

- **Recommendations.** (DoD 5000.2-M, PART 4-A, paragraph 9). The Program Executive Officer (PEO) and PM make recommendations on issues or trade-offs presented in the IPS and propose exit criteria (including HMC&M issues) for the next milestone.

Life Cycle Costs (LCC). LCC (Annex F) reflect the cumulative costs of developing, procuring, operating and supporting a system and are often estimated separately by budget account (i.e., RDT&E, procurement, and operations/maintenance). It is imperative to identify LCC, monetary as well as non-monetary, associated with each alternative in a cost and operational effectiveness analysis, particularly as they relate to HMC&M. DoDI 5000.2, PART 6, SECTION I requires that system LCC estimates include acquiring, using, and disposing of hazardous and potentially hazardous materials.

In accordance with DoDD 4210.15, cost factors include those expenses and cost avoidances associated with HM that may be reduced to monetary terms, including future liability. When considering HMC&M, LCC factors refer to direct and indirect costs attributable to HM encountered in operations including, but not limited to, acquisition, manufacture, supply, use, storage, inventory control, treatment, recycling, emission control, training, work place safety, labeling, hazard assessments, engineering controls, PPE, spill contingency, disposal, remedial action, and liability.

OPNAVINST 4110.2 also requires that decisions concerning HM use or substitution of less hazardous materials be supported by economic analyses which include cost factors and intangibles, such as savings from reduction in training and other related impacts. LCC of HMC&M requirements should be included when developing the average unit production costs. If the system requires the manufacturer to use materials and processes needing special controls, permits, and waste emission controls, these costs must be estimated and included. (The use of exotic materials in stealth technology is a good example).

3.5.5 Test and Evaluation Master Plan (TEMP)

The TEMP, a documentation requirement for ACATS I through IV and Milestones I through IV (DoDI 5000.2, PART 11, SECTION C), focuses on the overall structure, major elements, and test program objectives that are consistent with the acquisition strategy.

DoDI 5000.2, Part 6, Section I, requires that the TEMP assess critical health and safety issues in order to provide data for the safety analysis results. Environmental, safety and occupational health impacts must be carefully evaluated including manufacturing, maintenance and disposal. Other issues include additional HMC&M training for testing personnel, system safety considerations for testing isolated system components, or disposal of HW generated by the proposed test program.

3.5.6 The Integrated Logistics Support Plan (ILSP)

As required by OPNAVINST 4110.2, paragraph a., PMs for ACAT I, II and major ACAT III, must include plans and schedules for full scale implementation of HMC&M in the ILSP.

The ILSP documents the management approach, decisions, and plans associated with ILS planning for a system or equipment acquisition. Updated

during the acquisition process, the ILSP integrates all logistics aspects, controls ILS schedules, and identifies the interdependencies and interrelationships among ILS elements, design efforts, and deployment plans. For example, selecting the least hazardous material and the economic analysis decision process are addressed under the supply support element. This generates a need which may have to be considered in the initial environmental assessment (EA) addressed under the facilities element. Similar considerations may exist among other ILS elements.

An ILSP summary (including a brief summary of each element) is included in the ORD. Because the ORD is the primary aid in developing contracts and SOWs, incorporation of HMC&M into each ILSP element is very important. The following ILSP paragraphs describe where HMC&M considerations may be the most appropriate:

- **Introduction and Program Description**. This section includes a program overview, historical data, system description, illustrations, list of applicable program and logistics funding documents, support performance capability thresholds, concepts for operations and support, program schedule, and warranty requirements. HMC&M issue items should be mentioned in applicable areas. At Phase II, information concerning post production support should be included. Discussions of configuration control, engineering improvements for reliability, maintainability, and safety, and phase-out/planned life management should include HMC&M issues.

- **Maintenance Planning**. This section identifies basic maintenance concepts with detailed plans for maintenance plan approval, data collection, level of repair analysis, failure modes, effects and critical analysis, engineering technical services, warranties, depot designation, Navy support data, depot maintenance inter-servicing, and environmental impact assessment. Incorporating HMC&M into the Maintenance Planning element includes:

  --Identifying HMC&M requirements associated with maintenance activities and functions in the operational environment.

  --Specifying MIL-STD-1388-1A LSA requirements such as Tasks 301, "Functional Requirements Identification" and 401, "Task Analysis" in the ILSP and contract documents. MIL-STD-882B Tasks 202, "Preliminary Hazard Analysis" and 206, "Occupational Health Hazard Assessment" also identify hazards in maintenance functions and must be included in the ILSP.

  --Including HMC&M elements in Milestone and Gantt charts to ensure that results are in sequence with system acquisition milestones. For example, R&D results should be available for review and authorization well before Milestone III.

  --Including HMC&M results in various ILS elements and assessments of safety, health hazards and environmental risks which cannot be corrected or mitigated in the IPS. An LCC estimate should accompany these decisions.

- **Manpower and Personnel**. This ILSP element provides manpower requirements for operations and maintenance, support activity manpower, and manpower constraints. HMC&M issue items must include manpower/personnel requirements for hazards control, safety, and environmental constraints and should discuss the relationship between these and human factors (see SECTION B of PART 7, DoDI 5000.2). Other actions include:

  --Identifying specialized needs for manpower/personnel resources (such as authorizations for HM/HW handlers and operators; impacts on resources at support organizations because of additional hazard requirements associated with environmental compliance; and unique and specialized facilities for pollution prevention, etc.).

- **Supply Support**. This element includes identifying interim supply support, material support data, provisioning, requisitioning and turn-in procedures, spares acquisitioning integrated with production, and readiness-based sparing. Items to include:

  --With reference to OPNAVINST 4110.2, address any restrictions or changes for authorizing HMs, inputs to the HM AUL, and storage and handling requirements. Requirements for PPE, emergency response for spills and accidents, and monitoring of environmental and occupational hazards, should be included.

  --Specific plans for evaluating HM and substituting less hazardous items are integral to the supply support element as well as preparing LCC associated with HM.

- **Support Equipment**. This element identifies support equipment requirements documents, automatic test equipment, test program sets, built-in test and test equipment, metrology and calibration requirements, performance monitoring and fault location, tools and ancillary equipment, and support equipment allowance lists. Items to include:

  --Requirements to identify, categorize, receive, store, issue, use, and dispose of HMC&M equipment (including environmental monitoring devices, toxic and HM emission detection equipment, emergency response and spill control, evaluation and control devices and equipment, PPE, specialized HM/HW laboratory items, and HM/HW sensors and alarms).

  --HMC&M requirements associated with MIL-STD-1388-1A Task 401, Task Analysis. Pay attention to new items which require development. Requirements for PPE and disaster response associated with approved HMs must be included.

- **Technical Data (TD)**. This element includes the TD Management Plan, TD acquisition strategy, TD review activity, post-production support engineering data requirements, inventory control point data requirements, technical manual requirements, and software TD requirements. Other TD items to consider:

--Include all TD associated with the identification, monitoring, precautions, control, and disposal information for approved HM and resulting HW. Such data includes technical manuals, technical orders, maintenance instructions, and similar documentation of any form. TD should include specifications and standards for installation, operation, maintenance, training, support and system disposal.

--Procedures for developing principal Data Element Definitions (DEDs) in the LSAR are required and should include, for example, DED093-Economic Analysis, DED099-Environmental or HM Considerations, DED154-Hazard Code, DED155-Hazardous Maintenance Procedure Code, DED156-HM Storage Cost, DED362, Safety Hazards Severity Code, etc.

--The ILSP should contain HMC&M technical data for all non-developmental HM and ensure compliance with the requirements of MSDSs, labeling, waste disposal requirements, etc.

--Prior to an audit, the PM should confirm that the LSAR report, LSA-078, "Hazardous Materials Summary" (DID NO. DI-ILSS-80FFF) is included in SOWs and CDRLs.

- Training and Training Support. This element involves plans for training equipment with logistics support, contractor or factory training requirements, and types/numbers of students for each course. Additional considerations are:

  --Specific plans for imposing MIL-STD-882, Task 208, "Training," should be included in training SOWs. All system processes, procedures, techniques, and training devices involving HM and potential HW must be approved, including all elements of OSHA Hazard Communication Standard (HAZCOM).

  --If a system's approved HM results in new HW or new air and water emissions, training requirements must be included. Workplace and waste stream monitoring, emission control, spill controls, and maintenance and operation of control devices should be addressed in each training program.

- Computer Resource Support. This element includes LCC input and output data, HMC&M data, and data for hazard tracking/resolution throughout the acquisition process. Give consideration to imposing MIL-STD-882B, Task 105, "Hazard Tracking and Risk Resolution," on the contractor. Interfacing HMC&M issues with elements of the Computer Assisted Logistic Support (CALS) initiative should be examined and included as appropriate.

- Facilities. This element provides system facilities requirements including descriptions of all operational, support, and training sites; economic analysis of site facilities plans; and plans for public works support, etc. The PM should

coordinate HMC&M tasks associated with other elements that affect facility siting, environmental requirements, pollution prevention, and compliance with a wide variety of Federal, State, and local environmental codes, standards, and regulations. Principal HMC&M facility issues to include are:

--Developing preliminary environmental analysis data prior to Milestone I for inclusion in the IPS and the PEA data prior to subsequent milestones.

--Accomplishing design requirements for HM storage, HW storage and disposal, emissions controls, waste treatment, OSHA-required control measures, CAA most available control technology (MACT) requirements, and waste control requirements associated with EPA's water priority pollutants.

--Identifying, funding, and implementing plans and schedules for obtaining required environmental permits.

--Implementing MIL-STD-882B, Task 210, "Safety Compliance Assessment" in the system Contractor's SOW. Special attention should be given to task element 210.2.a relating to compliance with applicable codes, standards, and regulations.

--Including costs for construction, operation, and maintenance of environmental control facilities in LCC estimates.

- **Packaging, Handling, Storage, and Transportation (PHS&T).** PHS&T encompasses the resources, processes, procedures, design considerations, and methods to ensure that all system, equipment, and support items are preserved, packaged, handled, and transported properly. Also included are environmental considerations, equipment preservation requirements for short and long-term storage, and transportability. This element must address design considerations and measures to reduce pollution and HW through the following actions:

  --Minimizing hazards and resulting HW production.

  --Including emergency response equipment, PPE and communication requirements for transportation accidents involving HMs or HW.

  --Including requirements for transportation equipment, handling equipment, specialized packaging, and HMC&M equipment.

  --Notifying appropriate DoD, Navy, and civil authorities of spills and accidental releases.

  --Addressing issues such as the impact of shelf-life on storage, transportation and disposal requirements and costs (input to trade-off analysis involving HMs); development of special handling and disposal procedures regarding approved HMs; integration of system safety, environment, and health hazards requirements with human

factors studies; inclusion of residual risks and hazards associated with approved HMs in the IPS; and assurances that HM aspects of packaging, handling, storage, and transportation which effect the environment are included.

- **Design Interface.** This element defines the relationship of logistics-related design parameters, such as reliability and maintainability (R&M), to readiness and support resource requirements. Other important considerations are:

  --Design interface focuses on ensuring that the entire system (platform and delivery element, warhead, maintenance and support facilities, material, personnel, and management sub-elements) is designed to comply with pollution prevention needs. (Pollution prevention needs include environmental, system safety, and occupational safety and health issues).

  --Design interface reviews should include: results, conclusions, and actions on hazard and environmental analysis; determination of residual hazards associated with storage, transportation, use, and disposal of HM/HW; and, determination that alternatives to proposed HMs have been evaluated and the least hazardous selected (consistent with pollution emission and economic analysis).

  --Prior to Milestone III, a signed statement should be developed and approved to indicate that all identified hazards have been eliminated or controlled at levels acceptable to the Navy. Where remaining risks are at the high or significant level, appropriate approvals should be documented.

  --The method of choice to track hazards and environmental issues from earliest identification through approved design measures to eliminate or mitigate the hazards is to impose MIL-STD-882B, Task 105, Hazard Tracking and Risk Reduction and MIL-STD-1388-1A, Task 103, Program and Design Reviews.

3.5.7 Logistics Resource and Funding Plan (LRFP)

As prescribed by DoDD 5000.1, broad mission needs must be initially identified by the requirements generation system. Preliminary affordability decisions on proposed acquisition programs must be made in the planning, programming, and budgeting system process based on the Defense Planning Guidance, the approved long-range investment plans, and overall funding constraints.

Major cost/performance/schedule trade-offs must be made throughout program implementation, based on validated threat assessments, status of program execution, risk assessment, testing results, and affordability constraints brought about by changes in topline fiscal guidance. A program will not be approved to enter the next acquisition phase unless sufficient resources, including manpower, are or will be programmed to support projected development, testing, production, fielding, and support requirements.

The LRFP, a financial planning document, is developed and maintained by PMs at the inception of each ACAT I, II, and III program, concurrent with other program planning documents. The LRFP displays funding requirements and total program logistics resource requirements and ensures that these requirements are reflected in the Program Objective Memorandum (POM). As a requirements baseline document, it expresses claimant and sponsor commitment to meet the support requirements from programmed, budgeted, and appropriated funds and reflects the logistics program defined in the ILSP.

Related programs under SYSCOM claimancy, which are not systematically planned by another traceable requirements and funding process, include HMC&M. HMC&M funding requirements must be included in the LRFP to ensure they will have the necessary fiscal support throughout the acquisition life cycle.

3.5.8 Logistic Support Analysis (LSA)

This section highlights the MIL-STD-1388-1A (LSA) Tasks that may be implemented to meet DoDI 5000.2 requirements for hazard and risk assessments and HMC&M-related issues. These Tasks also serve as input to MIL-STD-882B Tasks. Not intended as a detailed exposition of the entire LSA process, this discussion provides guidance for validating the inclusion of HMC&M issues prior to and during an audit. (See Figure 3-2, Application of HMC&M Requirements in MIL-STD-1388-1A/2B).

A tailored LSA, used iteratively throughout the acquisition program, is integral to the systems engineering process. LSA is used to assist in complying with supportability and other ILS objectives through the process of definition, synthesis, tradeoff, test, and evaluation. MIL-STD-1388-1A implements the LSA guidelines and requirements established by DoDI 5000.2, and when performed in a logical and iterative manner, comprises the LSA process.

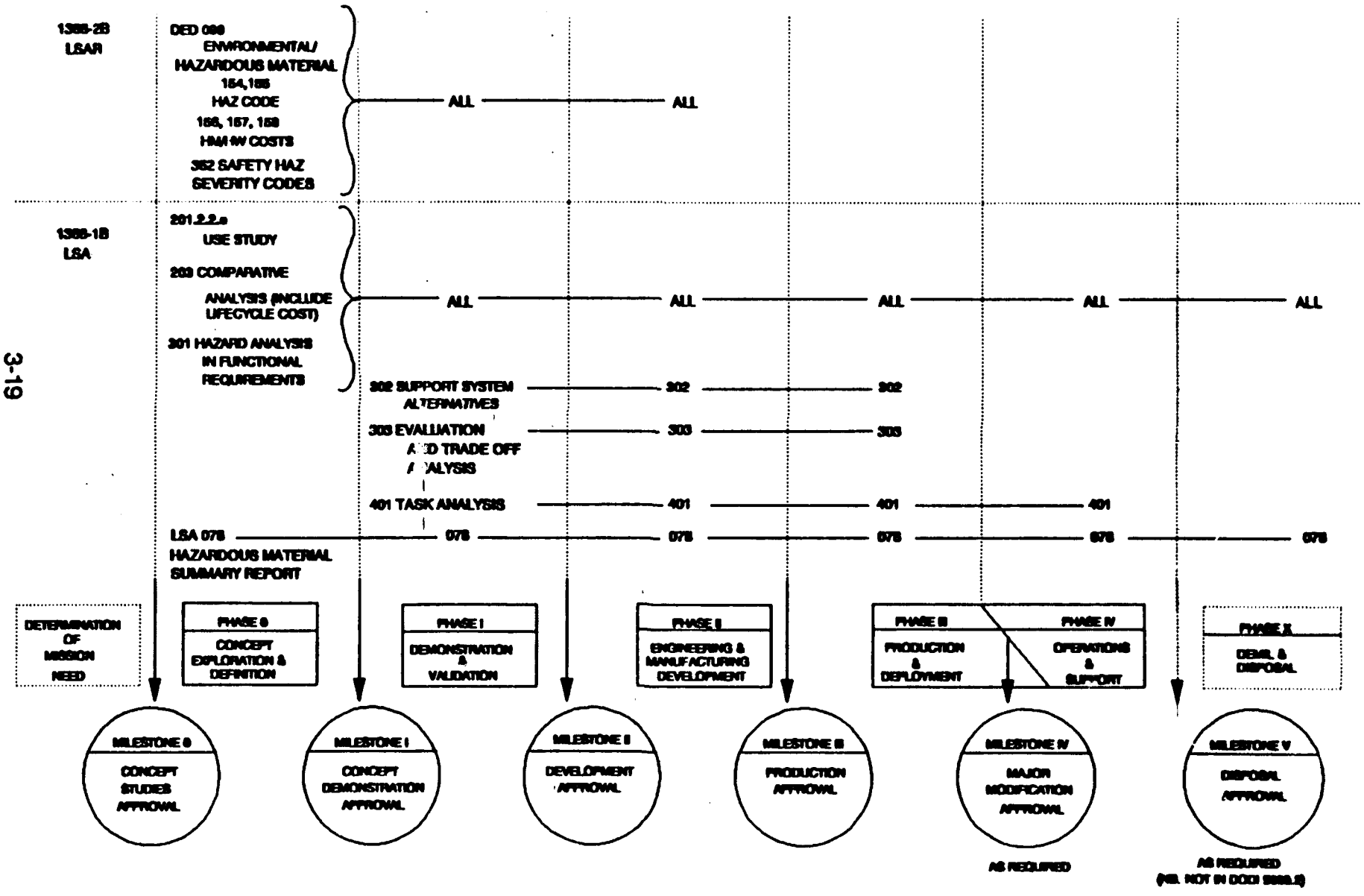
Increasing awareness that supportability factors such as manpower, personnel skills, and HMC&M considerations are critical elements in system effectiveness has necessitated early support analyses, system constraints, design goals, thresholds and selection criteria in these areas. Supportability factors also engender the pursuit of design, operational, and support approaches which optimize LCC and the resources required to operate and maintain systems.

LSA Tasks may be performed by PMs, ILS Managers, contractors, or Government field activities. Task results are documented in reports, test plans, Navy training plans, and in data delivered under support-related Data Item Descriptions (DIDs) cited on the CDRL, DD Form 1423. For ACAT I and II systems, LCC and support trade-off studies are required to determine cost drivers in both acquisition and support, from acquisition through system disposal.

When the LSA process is implemented contractually, more than the LSA SOW and supportability requirements must be appropriately integrated into specifications, general and special contract provisions, evaluation factors for award, instructions to offerors, and other sections of solicitation documents.

FIGURE 3 - 2
APPLICATION OF HMC&M REQUIREMENTS IN MIL-STD 1388-1A & 1388-2B TASKS

(NUMBERS REFER TO TASKS & DATA ELEMENT DESCRIPTORS (DED))



Task 103, Program and Design Reviews, requires the performing activity to provide for official review/control of design information with LSA program participation to ensure that milestones and supportability-related design requirements will be achieved. Under Subsection 103.2.2, formal review and assessment of supportability and supportability-related design systems are incorporated into each system/equipment design review. Section 103.2.2 also requires the identification of supportability-related design recommendations including a description, whether it has been approved or is pending, and the rationale for approval (e.g., cost savings, maintenance burden, reductions, supply support reductions, reliability improvements, safety or health hazard reduction, etc.).

Task 201, Use Study, documents the pertinent supportability factors related to the new system's intended use. Factors include mobility requirements, deployment scenarios, mission frequency and duration, basing concepts, anticipated service life, interaction with other systems, end items, operational environment, and human capabilities and limitations. Both peacetime and wartime employment are considered factors. Subsection 201.2.2.e documents quantitative data which must be considered in developing support alternatives and conducting support analysis and should also include, but not be limited to, environmental requirements such as HM, HW, and environmental pollutants.

Task 204, Technological Opportunities, evaluates design opportunities for improving supportability characteristics and requirements in the new system/equipment. Subsection 204.2.1 a., identifies technological advancements and design improvements to be exploited in the new system development which have the potential for reducing logistic support resource requirements, costs, environmental impact, or enhancing system readiness. Section 204.2.1.b., concerns estimating the improvements that would be achieved in the supportability, cost, environmental impact, and readiness values.

Task 205, Supportability and Supportability-Related Design Factors, establishes quantitative supportability characteristics resulting from alternative design and operational concepts and supportability and supportability-related design objectives, goals and thresholds, and new system constraints for inclusion in the program approval documents, specifications, or contracts, as approved. Subsection 205.2.4 establishes supportability, cost, environmental impact, and readiness objectives for the new system. It identifies risks involved in achieving system objectives and risks associated with new technology plans. Under Subsection 205.2.5, design constraints should address those related to HM, HW, and environmental pollutants.

Task 301, Functional Requirements Identification, identifies operational and support functions to be performed for each system or equipment alternative under consideration. Under Subsection 301.2.1, hazards to be identified include HM, HW, and environmental pollutants associated with operations and support functions. Subsection 301.2.2 identifies those functional system requirements which are unique due to design technology or operational concepts, or which are

supportability, cost, or readiness drivers. Hazards, including HM, HW, and environmental pollutants should be identified. Under Subsection 301.2.4, operational and maintenance tasks should include HM, HW generation, air and water pollutants releases, and environmental impacts associated with each task.

Task 401, Task Analysis, requires analyzing each operation and maintenance task required for the new system (Task 301) and determining the environmental impact of using HMs, generating HWs, and releasing air and water pollutants. Subsection 401.2.3 identifies new or critical logistic support resources and HM, HW, and environmental impact requirements associated with these resources. Subsection 401.2.5 identifies tasks which can be optimized to reduce operational support costs, optimize ILS requirements, and reduce environmental impact, including HM use, HW generation, release of air and water pollutants, and environmental impact, or enhance readiness.

Task 501, Supportability Test, Evaluation, and Verification, is used to assess the achievement of specified supportability requirements, identifies reasons for deviations from projections, and identifies methods of correcting deficiencies and enhancing system readiness. The assessment should consider environmental impacts as well as HMC&M. Subsection 501.2.2 involves developing a System Support Package (SSP) component list to identify support resources to be evaluated during logistic demonstrations and to be tested/validated during development and operational tests. The component lists should include items such as supportability test requirements, spare and repair parts, applicable Maintenance Allocation Charts (MACs), technical publications, manpower and personnel requirements, etc.

MIL-STD-1388-2B, "Logistics Support Analysis Record" (LSAR), prescribes Data Element Definitions (DEDs) required to support the ILS program of a systems acquisition. The MIL-STD is reviewed for all systems acquisition programs. The DEDs can be used for both manual and computer applications. In addition to the DEDs, DID report requirements are called for and, as above, need to be specified in the CDRL.

3.5.9 User Logistics Support Summaries (ULSS)

The ULSS (documentation of completed actions) provided by the PM identifies all logistics resources necessary to operate and maintain a system in its intended environment. The ULSS is made available to the site 90 days prior to initial operating capability (IOC) of the equipment. ULSS for ACAT I, II, and III programs should be prepared by equipment or system rather than by platform in order to facilitate a phased support transition approach. For ACAT IV projects, the ULSS may be issued as a revised and annotated ILSP, if this will reduce cost.

The ULSS, when approved, contains detailed information on the system including, but not limited to equipment nomenclature, description, inventory control point, maintenance concept and maintenance plan number, installation schedules (by site), allowance parts list, technical documentation list, support equipment list, training courses,

software support, facilities, configuration control and engineering change procedures, and HM and safety considerations.

At the IOC, the LRG audit team members should review the ULSS and validate that HMC&M and safety considerations have been addressed and updated in the ILSP and executed throughout the system acquisition process.

3.6 INCORPORATING MIL-STD TASK ELEMENTS INTO STATEMENTS OF WORK (SOWs)

A basic approach to incorporating HMC&M requirements into SOWs is to: identify HM associated with a weapon system concept; evaluate/analyze the consequences in terms of human health, safety, and the environment (both on and off site); and eliminate, substitute, and/or control HM to acceptable limits consistent with military, costs, and regulatory requirements. This overall approach should be used in the introduction to the Statement of Work.

The Tasks described in MIL-STDs 882B, 1388-1A, and 1388-2B can serve as major tools for incorporating HMC&M-related requirements into SOWs. MIL-STD-1388-1A/-2B requirements are especially important in developing cost data (including HMC&M) for inclusion in required economic analyses and as inputs to the ILSP.

3.6.1 Tailoring MIL-STD Tasks

Because weapon system contractors and subcontractors play an increasing role as a system acquisition moves beyond Milestone 0, HMC&M program needs may not be met unless they are incorporated into acquisition documents such as SOWs and source evaluation criteria. Without adequate allocation of contractor and PM staff resources (personnel and funds), there may be critical HMC&M deficiencies that result in certification-dependent audit findings which may delay system certification for the next phase and delay the scheduled deployment date.

"Tailoring" is the process of stating specific requirements for generic items contained in each task description. MIL-STDs 882B and 1388-1A provide a series of task descriptors to be tailored by the PM and incorporated in SOWs or established as tasks to be accomplished by the PM or designated staff. These MIL-STDs also provide DIDs for reporting results of task-related actions. The SOW should cite the specific task elements needed and require submittal of DID reports. Task requirements should be stated in the CDRL.

The MIL-STD-1388-1A Tasks relevant to HMC&M were presented earlier in subsection 3.5.8. A synopsis of MIL-STD-882B Task requirements follows. The Tasks of both MIL-STDs are important tools for incorporating HMC&M into SOWs.

3.6.2 Synopsis of MIL-STD-882B, System Safety Program Requirements

The Task 100 series of MIL-STD-882B concerns program management and control, whereas the 200 series is for specific hazard evaluations. Appendix A to MIL-STD-882B contains detailed guidance for accomplishing a hazard risk assessment and developing a risk assessment code (RAC). The RAC is of major

importance in complying with the requirement found in DoDI 5000.2, PART 6, SECTION I for identifying serious and high risk hazards. Figure 3-3 presents the phased application of relevant MIL-STD-882B Tasks for HMC&M requirements. (See Chapter 4 for additional information on deriving the estimated RAC).

System Safety Requirements, paragraphs 4.5, 4.5.1, 4.5.2 and Appendix A (paragraph 30.3) establish the methodology for categorizing hazard severity and hazard probability and then developing a Risk Assessment Code (RAC). PART 6, SECTION I, requires this system be used in assessment of hazards which have to be accepted. (See Figure 3-4 for the "Risk Assessment Matrices" as presented in MIL-STD-882B).

Task 105, Hazard Tracking and Risk Resolution, provides for establishment of procedures to document and track hazards from time of identification until hazard control, mitigation, or elimination.

Task 106, Test and Evaluation Safety, incorporates into the TEMP the recommended actions to reduce or correct hazards associated with system testing and evaluation (e.g., test and evaluation plan involving platforms that have large size lithium batteries must take into account the possibility of toxic releases in the event of a test accident).

Task 201, Preliminary Hazards List, provides for compilation, very early in the system acquisition life cycle, of a list of identified possible hazards to be considered as the system design develops.

Task 202, Preliminary Hazards Analysis (PHA), which is started before Milestone 0 and continued into Phases 0 and I, is used to assess hazardous components (e.g., fuels, propellants, lasers, explosives, toxic substances, hazardous materials, environmental pollution, etc). It includes risk assessments and the broadest scope of needs for controls, facilities, equipment and training. The PHA also includes such possible hazards as shock (excessive g forces), temperature and pressure extremes, noise, human factors, etc.

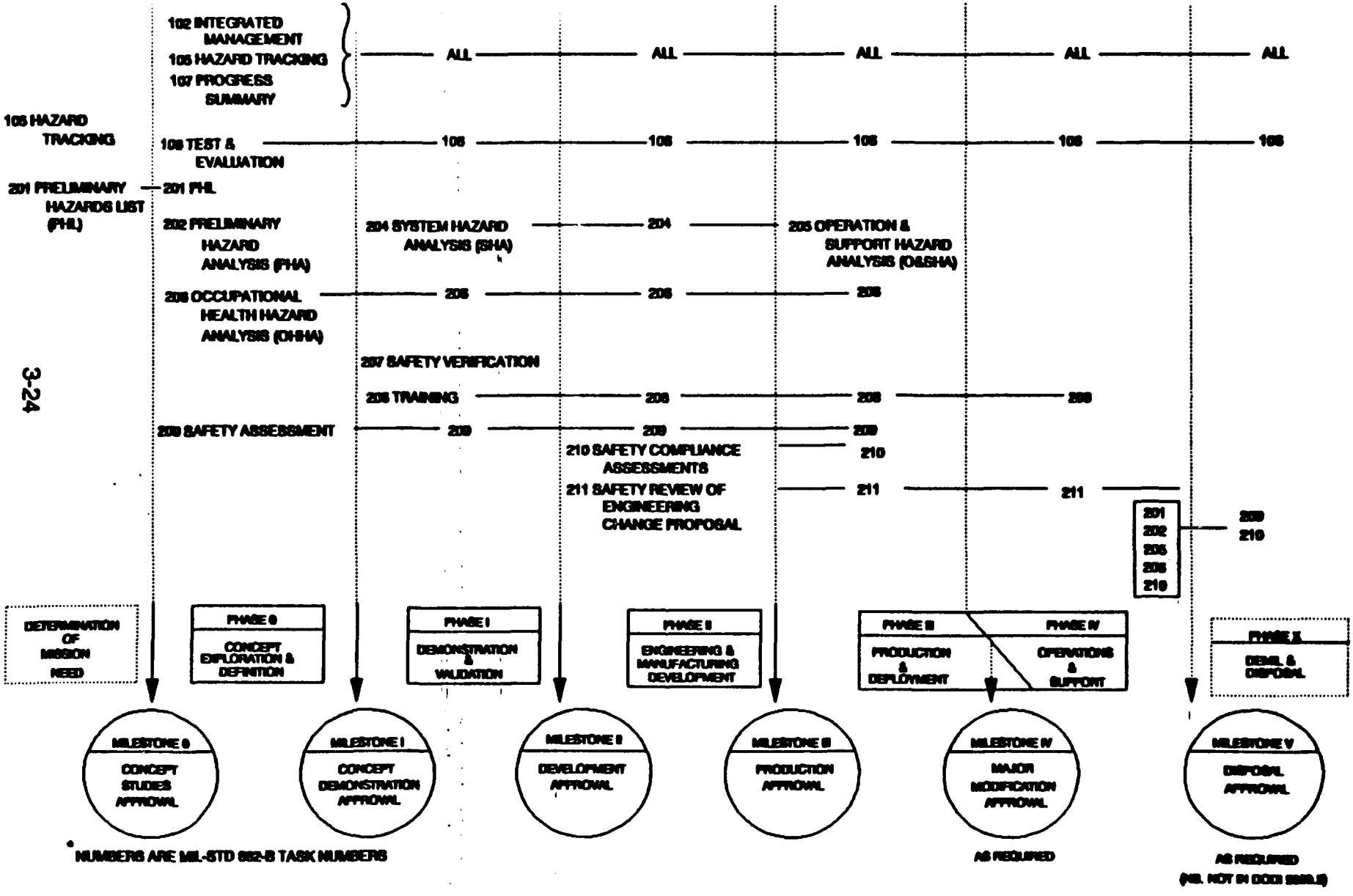
Task 205, Operating and Support Hazards Analysis, evaluates hazards and identifies design changes needed to eliminate or control them. Hazards in handling, storage, transportation, maintenance operations, and disposal of HM must be considered.

Task 206, Occupational Health Hazard Assessment, is used to perform and document assessments of identified health hazards and to propose protective measures. Recommendations are developed for engineering controls, equipment, and protective procedures (Note: the latter may include substitution of less hazardous items). The assessment considers all toxic materials, physical agents (e.g., noise, heat or cold, ionizing and nonionizing radiation), and identifies all needed design requirements.

Task 208, Training, assesses the requirements for personnel training to ensure recognition of hazards, their cause and effects, preventive and control measures, etc.

FIGURE 3-3
PHASED APPLICATION OF MIL-STD 882B TASKS*
FOR HMC&M REQUIREMENTS

(NOTE: OUTPUT/REPORTS ARE INPUTS TO LSA/LSAR AND PROGRAMMATIC ANALYSIS)



*NUMBERS ARE MIL-STD 882-B TASK NUMBERS

FIGURE 3 - 4
MIL-STD-882 RISK ASSESSMENT MATRICES
First Example: Hazard Risk Assessment Matrix

FREQUENCY OF OCCURENCE	HAZARD CATEGORIES			
	I CATASTROPHIC	II CRITICAL	III MARGINAL	IV NEGLIGIBLE
(A) FREQUENT	1A	2A	3A	4A
(B) PROBABLE	1B	2B	3B	4B
(C) OCCASIONAL	1C	2C	3C	4C
(D) REMOTE	1D	2D	3D	4D
(E) IMPROBABLE	1E	2E	3E	4E

Hazard Risk Index	Suggested Criteria
1A, 1B, 1C, 2A, 2B, 3A	Unacceptable
1D, 2C, 2D, 3B, 3C	Undesirable (MA decision required)
1E, 2E, 3D, 3E, 4A, 4B	Acceptable with review by MA
4C, 4D, 4E	Acceptable without review

Second Example: Hazard Risk Assessment Matrix

FREQUENCY OF OCCURENCE	HAZARD CATEGORIES			
	I CATASTROPHIC	II CRITICAL	III MARGINAL	IV NEGLIGIBLE
(A) FREQUENT	1	3	7	13
(B) PROBABLE	2	5	9	16
(C) OCCASIONAL	4	6	11	18
(D) REMOTE	8	10	14	19
(E) IMPROBABLE	12	15	17	20

Hazard Risk Index	Suggested Criteria
1 - 5	Unacceptable
6 - 9	Undesirable (MA decision required)
10 - 17	Acceptable with review by MA
18 - 20	Acceptable without review

Note: MA = Managing Authority
Source: MIL-STD-882B (Appendix A, 1984)

Task 209, Safety Assessment, and Task 210, Safety Compliance Assessment, which are relevant to Milestone exit criteria, summarize criteria and methodology used and hazards that still have a residual risk. This Task also requires a list of all HM and copies of MSDSs. Task 210 verifies compliance with all DoD, Navy, Federal, state and local codes, standards and directives. HM identification as well as precautions and procedures for safe storage, handling, transport, use, and disposal of the material are required.

DID-DI-H-7049 Safety Assessment Report, identifies specific formats for the report.

3.6.3 Steps For Including HMC&M In Statements Of Work

HMC&M requirements should be incorporated into the formal SOWs in coordination with the Contracting Officer. HMC&M elements must provide specific information on the performance expected of contractors and subcontractors. Among the most critical elements to impose are environmental analyses of specific MIL-STD "tasks," specified reports in the CDRL, and the proposal evaluation criteria.

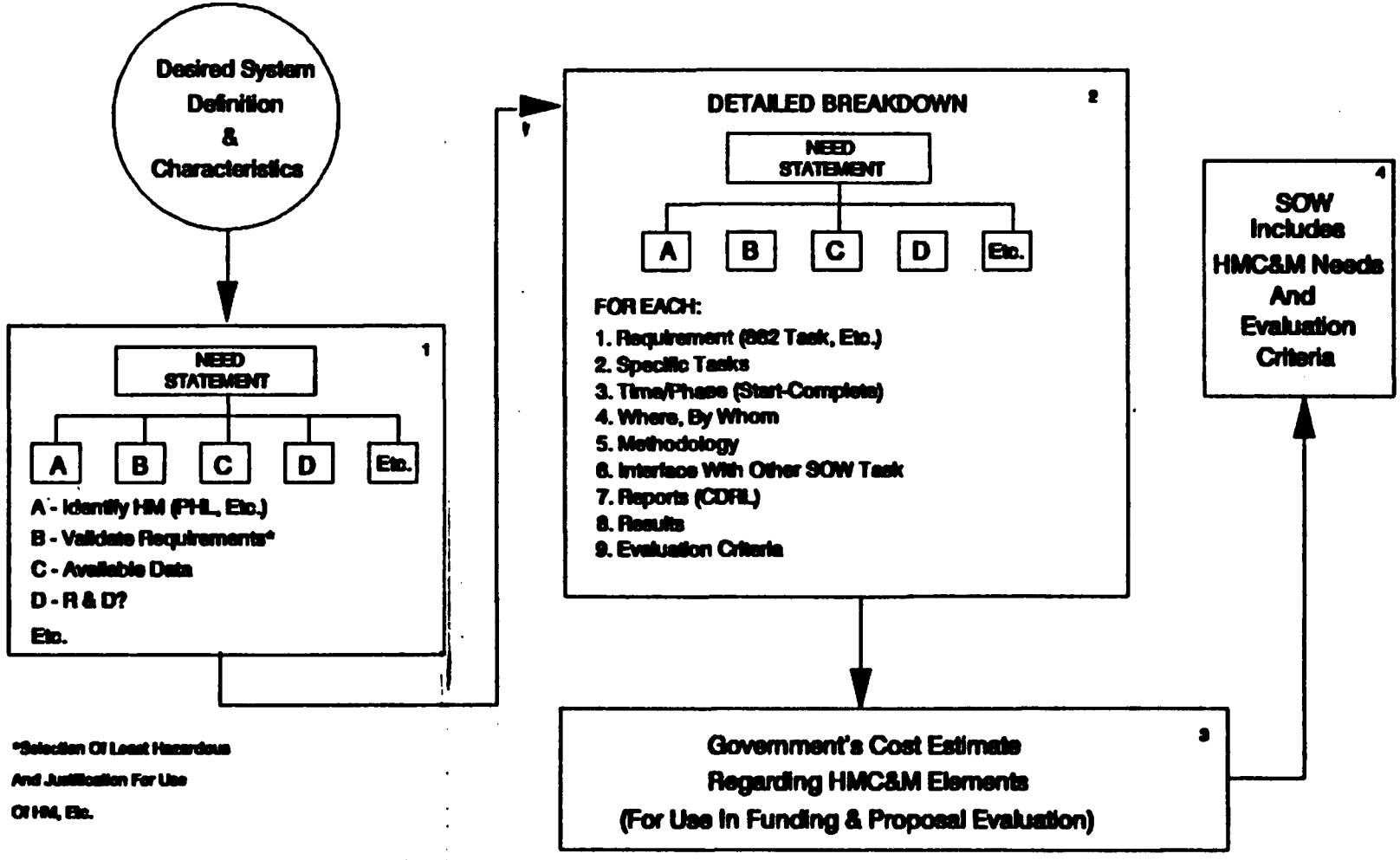
A concept for developing input to SOWs is depicted in Figure 3-5. Recognizing that there may be a series of iterative contracts requiring a SOW, only general suggestions for inclusion of HMC&M requirements are provided. The degree of specificity increases in Phases I and II and will be increasingly more difficult to achieve after Phase II, if prior requirements have not included HMC&M.

To ensure HM control, occupational and environmental hazards control, and HW reduction, contractors will be required to identify all processes and material alternatives involved with HM as defined in FED-STD-313, CFR 40-49 series, and OSHA 29 CFR. To meet this requirement, contractors will accomplish and document MIL-STD-882B, Task 105, "Hazard Tracking and Risk Resolution"; Task 201, "Preliminary Hazards List"; Task 202, "Preliminary Hazards Analysis"; Task 205, "Operating and Support Hazards Analysis"; Task 206, "Occupational Support Hazards Analysis"; Task 208, "Training"; Task 209, Safety Assessment"; and Task 210, "Safety Compliance Assessment," at the time phases shown previously in Figure 3-3.

Tasks 209 and 210 will be completed prior to each major milestone. Results of these analyses will include a RAC for each hazard, as provided in Appendix A, MIL-STD-882B. Each analysis will be reported in a Safety Assessment Report, DID DI-8-7049. The Safety Assessment Report will include written justification that indicates that suitable alternatives for HM requirements have been investigated, those selected are the least hazardous, and that an economic analysis has been accomplished. MSDSs for HM will be provided with the Safety Assessment Report.

In accordance with DoDI 5000.2, PART 6, SECTION I, when proposed HM are of a high or serious risk category as defined in Appendix A, MIL-STD-882B, full justification will be provided for inclusions in LSA Task 201, "Use Study," and for submittal to DASN RD&A for approval. System Safety Hazard Analysis Report DID DI-H-7048 will be used.

FIGURE 3 - 5
STATEMENT OF WORK - BUILDING BLOCKS
FOR
HAZARDOUS MATERIAL CONTROL AND MANAGEMENT (HMC&M)



Contractors will utilize the following order of precedence in selecting materials for use in weapon systems and nondevelopmental items:

(1) Nonhazardous materials.

(2) Materials which are demonstrably least hazardous of possible alternatives, meeting both feasibility and cost effectiveness.

(3) Materials that are reusable or recyclable.

(4) Materials for which cost effective control and waste disposal technology are readily available to meet codes, standards, and regulatory requirements (Federal, State, and local--as specified herein).

Contractors will incorporate environmental, safety, and occupational health requirements into all maintenance procedures, manuals, and system and subsystem documentation when HM are required and approved by the Contracting Officer. Contractors will reference the appropriate group of OPNAV P-45-110-91, MSDS data, and special environmental precautions. (OPNAV P-45-110-91 is the Hazardous Material Users Guide).

3.6.4 Imposition of MIL-STD-1388-1A and -2B Tasks

Contractors will be required to accomplish LSA Task 201, "Use Study," which should include the results of MIL-STD-882B hazards analyses. The study will justify, from a HMC&M perspective, reasons why a process and HM were selected or recommended for approval, and will identify all HM used in operations and maintenance. All HM will be documented to include:

(1) Potential and actual health hazards (including providing copies MSDSs).

(2) Pollutants and waste streams (air, liquid, solids) generated by each maintenance process and operational system, by volume and percent.

(3) Hazard minimization and environmental control measures required and disposal methods.

(4) Justification showing analysis of alternatives for less hazardous materials and reasons why (including an economic analysis) that the materials required are the least hazardous meeting mission requirements and no suitable substitute is currently acceptable. If the HM constitute a "Serious" or "High Risk" (MIL-STD-882B, RAC I or II), contractors are to provide the PM with an in-depth System Safety Hazard Analysis Report, DID DI-H-7048, for submission to DASN RDT&A. For ACAT III and IV, an Occupational Safety and Health Assessment Report, DID DI-SAFT-80616 should be provided.

The LSA Task 203, "Comparative Analysis" will include the justification for selecting and/or substituting HM. Contractors will show the impact of each HM alternative, including the potential for noncompliance with such restrictive regulations as those for volatile organic compounds. The comparative analysis will include LCC considerations and economic

analyses of HM alternatives. This data should also be reported in LSAR DED 156, 157, and 158.

In response to Task 204, "Technological Opportunities," contractors will evaluate, among the basic tasks, all processes that use HM and generate HW, occupational hazards, or environmental pollutants, along with opportunities for eliminating or mitigating those materials approved for use in the system. And when considering Task 205, Supportability, the contractor will identify and document design constraints related to HM, HW, and environmental pollutants. Results of MIL-STD-882 and EAs will be utilized.

Quantitative requirements will be documented in LSAR DEDs 099, 105, 156-158.

In relation to Task 301, "Functional Requirements Identification," the contractors will identify HM, HW generation, release of air and water pollutants, and environmental impacts associated with each task. Data will be incorporated into the relevant LSAR DED (refer to Figure 3-2).

For Task 401, "Task Analysis," contractors will identify ILS resources associated with new, approved HM, HW, and environmental impacts. Special attention will be given to Air Toxics (EPA 40 CFR), RCRA, and EPCRA requirements for reporting, tracking, monitoring, and reporting HM, as well as environmental permits and emergency procedures. Requirements for monitoring, training, testing, and computer support are to be identified with cost implications. Contractors will propose improvements to tasks which reduce environmental impacts and occupational hazards and minimize HM use and HW generation. Results will be reported in LSAR DEDs (see Figure 3-2).

LSAR Report LSA-078, "Hazardous Materials Summary," will be submitted by contractors to summarize all HM required to support each selected end item. This report is required per DID-DI-ILSS-80FFF.

CHAPTER 4

GUIDANCE FOR SELECTION/SUBSTITUTION OF LESS HAZARDOUS MATERIALS

CHAPTER 4.0

"GUIDANCE FOR SELECTION/SUBSTITUTION OF LESS HAZARDOUS MATERIALS"

4.1 INTRODUCTION

A substitution methodology has been designed to assist the Navy with its decision-making responsibilities in reducing HM use. Examples of such HM substitutions are replacing an existing Navy AUL item, replacing an existing DoD Federal specification material, or selecting the least hazardous of two or more materials for use in a new system.

The methodology presented here is an initial screening device for ranking existing materials by properties which may affect health, safety, and the environment. In addition, information is provided on categorizing, prioritizing, and finding substitutes for such categories of HM.

The substitution methodology may also assist PMs in identifying "high" or "serious" risks which require special approval, in accordance with DoDI 5000.2, Part 6, Section I. Please note that the methodology described herein is not to be considered the sole determining selection method, but rather a screening device to be used in conjunction with economic analyses, mission needs analyses, and other elements which serve as input for decision models.

4.1.1 HM Substitution And Environmental Regulations

One of the primary objectives in preventive engineering, when considering environmental, safety, and health needs, is to reduce impacts from hazardous chemicals. The concept of substituting less hazardous material for more hazardous ones and changing processes and procedures to improve production efficiency, while minimizing costs, are not recent developments.

However, a new impetus has developed within the Military Departments, particularly the Navy, toward meeting the growing number of Federal and DoD environmental policy requirements. The mandates of DoDD 4210.15, DoDI 5000.2, Part 6, Section I, and OPNAVINST 4110.2 share commonality by requiring that the least hazardous or non-hazardous material be selected (consistent with military requirements), based on risk assessments and economic analyses (which can include LCC considerations). Implementing the proposed substitution methodology should assist users in meeting not only the requirements of DoD and Navy Directives, but a wide range of Federal, State, and local regulations.

4.1.2 Relationship To Other Elements Of The Decision Process

As stated above, substitution analysis is only one input to a larger decision process whose scope and extent may include:

(1) The phase of the system acquisition development cycle.

(2) LCC and benefit determinations and inputs to and results of economic analyses.

(3) Input and output from LSA reports (Per MIL-STD-1388-1A).

(4) Subjective judgmental factors and considerations including: the criticality of the material to the mission; project phase; liability concerns; and the subjective weighing of factors such as health, safety, environment, costs, timing considerations, etc.

Figure 4-1 presents a decision model for the evaluation and substitution of HM.

4.2 OVERVIEW OF THE SUBSTITUTION PROCEDURE

The substitution methodology consists of an algorithm which is used to assign numerical "points" to such elements as toxicity, duration of expected exposure, medical effects, fire and explosion potential, numbers of personnel affected, and a limited assessment of environmental impact and control. The "points" are then totaled, thereby providing a numerical score and a DoD Risk Assessment Code (RAC) number. This approach allows for comparing one material's Hazardous Material Selection Factor (HMSF) with another. The results can also be used for entry into any decision analysis procedure.

The ultimate version of the substitution methodology would include computer modules containing OSHA's Permissible Exposure Limits (PEL), EPA's Hazardous Substances List, DOT's list of flammable/combustible liquids, Clean Air Act of 1990 list of mandatory air toxics, etc. Once a material's MSDS (from the manufacturer or HMIS) and other data are available and the basic information entered, the computer system would rapidly produce the HMSF. The non-computerized version of the algorithm also allows for rapid computation.

4.2.1 Understanding The Methodology

During the late 1950s, DoD recognized that identifying hazards which could affect a weapon system's performance was a critical element in the acquisition process. Such hazards can cause system failures that result in the system not meeting its mission requirements and failures that can result in harm to people, the system, or its components. As a result, systems engineering and its subset, system safety, came into being as MIL-STD-882 about 1960.

A series of phased but related Hazard Analyses (Preliminary Hazard List, Preliminary Hazard Analyses, Operational and Support Hazards Analysis, etc.) were incorporated into the MIL-STD scheme. These Hazard Analyses have been carried forward into the current MIL-STD-882B.

FIGURE 4 -1a

DECISION MODEL FOR EVALUATION AND SUBSTITUTION OF HAZARDOUS MATERIALS

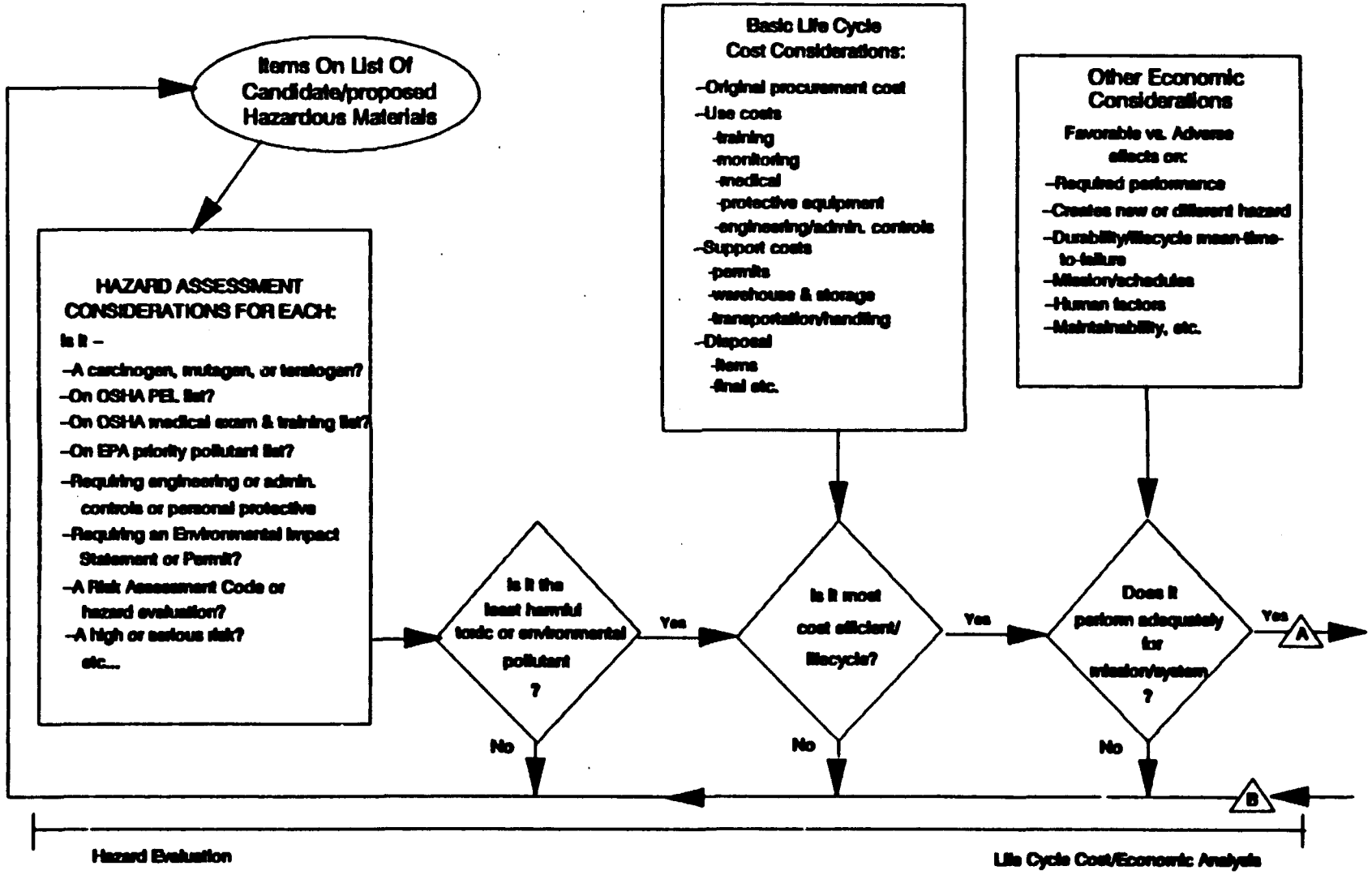
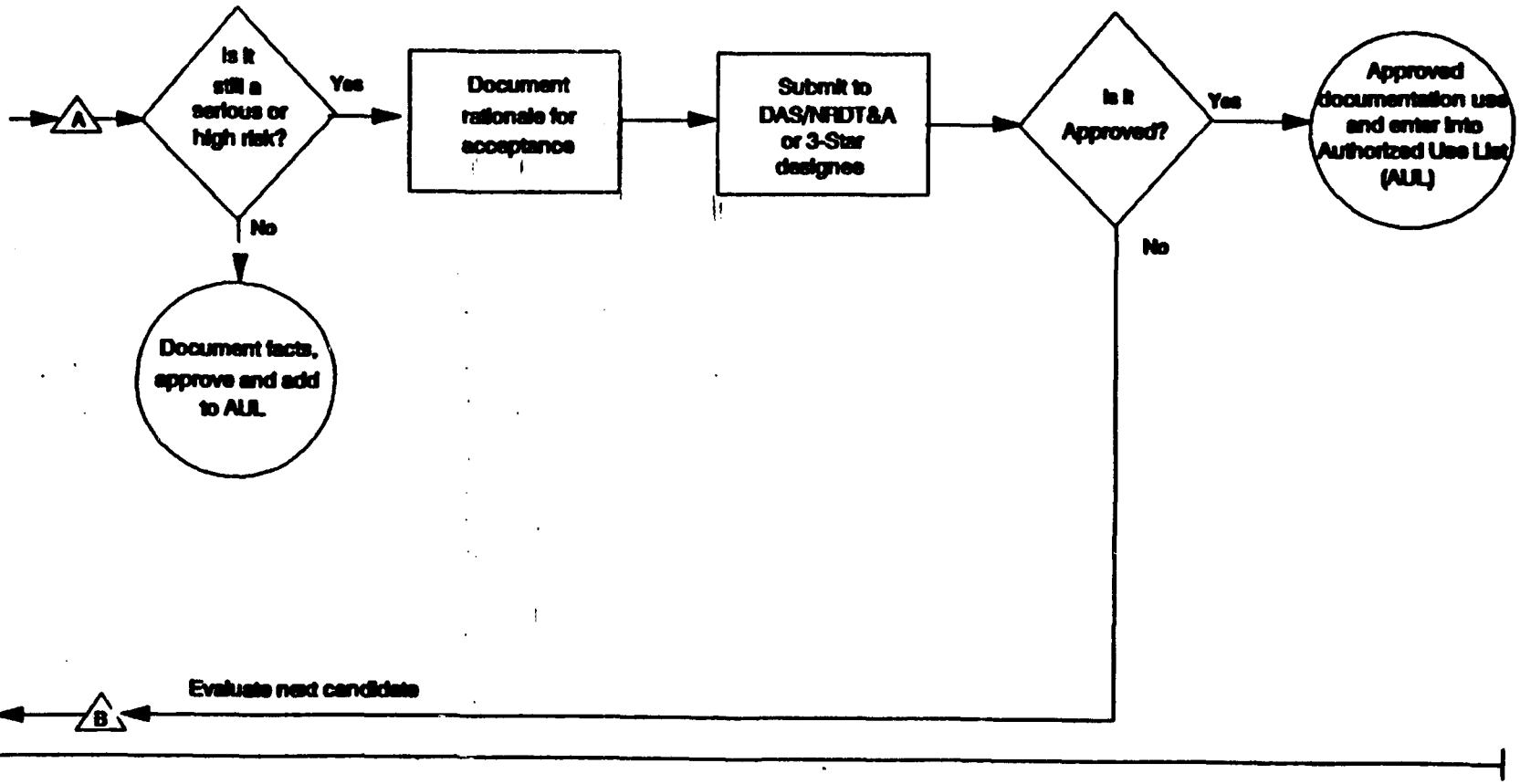


FIGURE 4 - 1b
DECISION/APPROVE



Recognizing that some standard methodology was needed to characterize the results of these analyses, the MIL-STD called for a rating scheme based on a matrix of estimating severity of occurrence and probability of occurrence. Thus, the Risk Assessment Code (RAC) was created.

Figure 4-2 provides an illustration of the Risk Assessment Matrices found in MIL-STD-882. The methodology described is based on the current RAC specified in DoDI 6055.1, DoD Occupational Safety and Health Program, MIL-STD-882, MIL-STD-1388-1A, MIL-STD-1388-1B, and OPNAVINST 5100.23, Navy Occupational Safety and Health (NAVOSH) Program Manual.

DoDI 6055.1A, Department of Defense Occupational Safety and Health Program (dated 9 September 1981), adapted MIL-STD-882 RAC procedures to rate occupational safety and health (OSH) deficiencies. The key changes were in definitions of Hazard Severity and numbered RACs (see Figure 4-3, Deriving Estimated Risk Assessment Code). A cost effectiveness index (CEI) and abatement priority number system were designed to assist the Military Departments in establishing priorities for funding abatement projects to correct OSH deficiencies. The Military Departments each issued implementing directives.

In Change 1 to DoDI 6055.1 (dated 11 April 1989), it was recognized that separate methods were needed for deriving RACs for occupational safety and health hazards. The safety hazard RAC method continued the use of descriptive definitions to identify the Hazard Severity and Mishap Probability codes in the prior RAC matrix. For health effects, an improved RAC methodology, which took into account circumstances of exposure and resultant health effects, was established.

The Hazard Severity and Mishap Probability codes are obtained using the PEL, results of exposure (death to minimal loss time), number of employees exposed, and exposure type (daily, 8 hours/day, 1-2 hours/week) which are factored into the RAC matrix. (See Figure 4-4 which contains the prior version of the RAC matrix developed under DODI 6055.1.) This methodology is firmly established within the Military Departments' OSH hazard assessment and abatement priority procedures.

The principal deficiency of the abatement priority system is its failure to relate exposure factors and environmental requirements, as discussed below. The RAC schemes mentioned above have dealt primarily with chemical and safety hazards ratings, with no consideration for environmental ramifications.

Recently, there has been an increased focus on the decision-making process and environmental aspects of HM use. Unlike the long history of chemical and safety hazards rating schemes, there are no universally accepted systems for environmental hazards and risk acceptance. The only "metrics" currently applicable to the substitution model includes two used by EPA in its regulatory analyses. Congress has mandated that EPA adopt regulations that, in effect, protect the most sensitive element exposed, human or biosphere. This mandate, however, does not address the complex issues that the Navy must weigh in HM selection and substitution within a system that is mission-driven.

FIGURE 4 - 2
MIL-STD-882-RISK ASSESSMENT MATRICES
First Example: Hazard Risk Assessment Matrix

FREQUENCY OF OCCURENCE	HAZARD CATEGORIES			
	I CATASTROPHIC	II CRITICAL	III MARGINAL	IV NEGLIGIBLE
(A) FREQUENT	1A	2A	3A	4A
(B) PROBABLE	1B	2B	3B	4B
(C) OCCASIONAL	1C	2C	3C	4C
(D) REMOTE	1D	2D	3D	4D
(E) IMPROBABLE	1E	2E	3E	4E

Hazard Risk Index	Suggested Criteria
1A, 1B, 1C, 2A, 2B, 3A	Unacceptable
1D, 2C, 2D, 3B, 3C	Undesirable (MA decision required)
1E, 2E, 3D, 3E, 4A, 4B	Acceptable with review by MA
4C, 4D, 4E	Acceptable without review

Second Example: Hazard Risk Assessment Matrix

FREQUENCY OF OCCURENCE	HAZARD CATEGORIES			
	I CATASTROPHIC	II CRITICAL	III MARGINAL	IV NEGLIGIBLE
(A) FREQUENT	1	3	7	13
(B) PROBABLE	2	5	9	16
(C) OCCASIONAL	4	6	11	18
(D) REMOTE	8	10	14	19
(E) IMPROBABLE	12	15	17	20

Hazard Risk Index	Suggested Criteria
1 - 5	Unacceptable
6 - 9	Undesirable (MA decision required)
10 - 17	Acceptable with review by MA
18 - 20	Acceptable without review

Note: MA = Managing Authority
Source: MIL-STD-882B (Appendix A, 1984)

FIGURE 4 - 3
DERIVING ESTIMATED RISK ASSESSMENT CODE

Pending publication of DoD Manual 6055.1-M, use this matrix and descriptive definitions below to estimate the Risk Assessment Code (RAC). DoD Manual 6055.1-M, when issued, will contain the methodology to define more precisely severity and probability factors and their relationship to exposure.

MISHAP PROBABILITY

		A	B	C	D
Hazard Severity	I	1	1	2	3
	II	1	2	3	4
	III	2	3	4	5
	IV	3	4	5	5

HAZARD SEVERITY

I -Death or permanent total disability.
II -Permanent partial disability or temporary total disability in excess of three months.
III -Lost workday mishap/compensable mishap.
IV -First aid or minor supportive medical treatment, or simply violation of standard.

MISHAP PROBABILITY

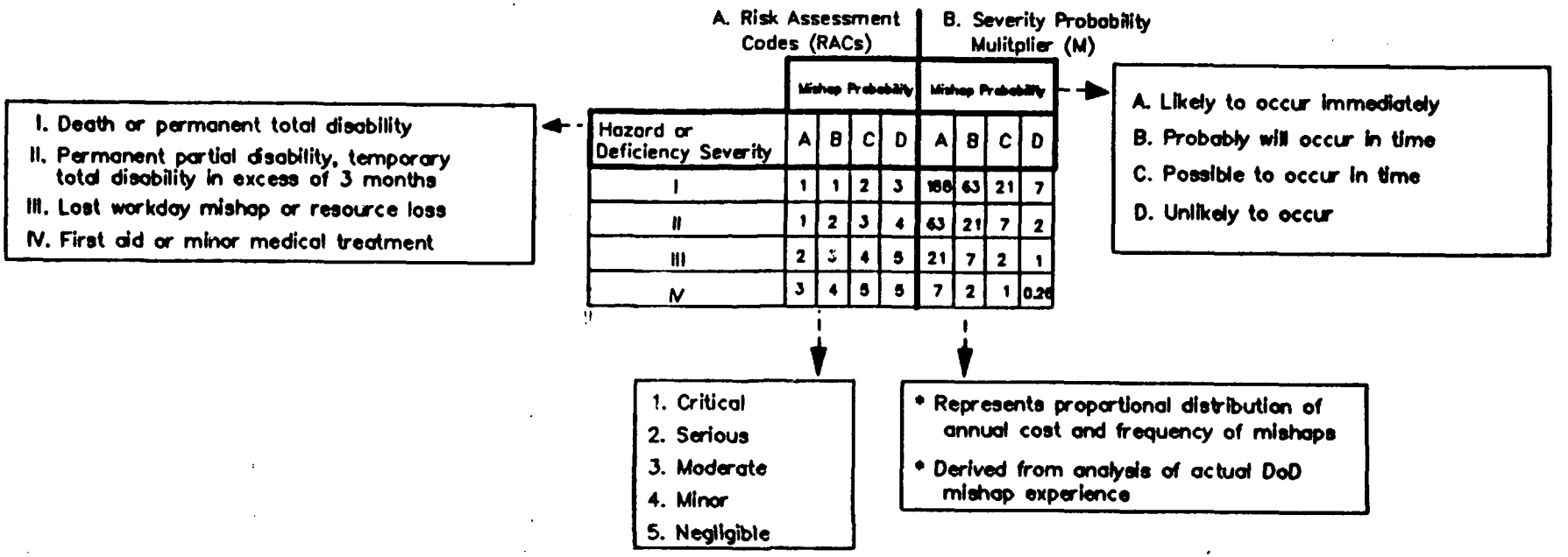
A -Likely to occur immediately.
B -Probably will occur in time.
C -Possible to occur in time.
D -Unlikely to occur.

RACs

1 -Critical
2 -Serious
3 -Moderate
4 -Minor
5 -Negligible

Source: DoDI 6055.1A, Table 1
(revised 9 Sep 1989)

FIGURE 4-4 - DODI 6055.1 MODEL



C. Methods of Abatement

ABATEMENT ACTIONS

- Substitute less hazardous material or less hazardous process
- Eliminate hazards through engineering changes or control
- Isolate hazardous operations to minimize exposure
- Provide work around procedures
- Provide administrative controls to reduce length of exposure

OTHER CONSIDERATIONS

- Technical feasibility and cost of available options
- Number of personnel exposed and time they are exposed
- Previous mishap experience
- Future intended use of facility or equipment
- Available alternative methods to control hazard or protect personnel
- Interim control procedures in effect

D. Prioritization of Abatement Actions

- Determine exposure (E) or average number of personnel exposed daily to hazard or deficiency during course of year
- Determine cost of abatement (C). If unknown use best available estimate
- Compute Cost Effectiveness Index (CEI)

$$CEI = \frac{C}{M \times E}$$

- Determine APN by listing RAC (CEI)
- Determine relative priority of abatement project by comparing CEI of projects with identical RACs (can't compare projects with different RACs)

The procedures in DoDI 6055.1 have been adapted to include environmental attributes and to establish a rating system compatible with the requirements for identifying "high" and "serious" risks called for in DoDI 5000.2, Part 6, Section I.

4.2.2 Understanding the Points Utilized In This Method

To understand the basis for the "points" utilized in the proposed substitution methodology, the user should have familiarity with the following:

a. Toxic Effects. The evaluation should contain the frequency and duration of possible worker exposure, including whether the material presents toxic hazards on brief, short term exposures associated with high concentrations and accidental releases, or whether it causes harm primarily from extended exposure to relatively low concentrations. Materials which are skin irritants, sensitizers, or suspected or known carcinogens, teratogens, or mutagens require special attention, even if the projected quantities are small.

In many instances the MSDS only summarizes the toxicity data of a mixture's individual components and does not provide information concerning specific toxicological studies on the material itself. In such cases, judgments should be based on consultation with such approved sources as the Navy Environmental Health Center. Also, give attention to information that indicates that the material possesses allergenic properties or is a known skin sensitizer. (A suggested reference is the NIOSH "Pocket Guide to Chemical Hazards," available from the US Government Printing Office.)

b. Physical Characteristics. Materials with a high vapor pressure are more likely to be dispersed into the environment. Those with low flash and boiling points (flash point lower than 73 degrees F and boiling point below 100 degrees F) are extremely hazardous from a fire and explosion viewpoint, when contrasted with those with flash points greater than 100 degrees F. Liquids with specific gravities less than 1.0 present fire spreading hazards because such materials float on water. A "toxic material" with a high vapor pressure is more of a hazard in a confined work area than one with the same toxic properties with a much lower vapor pressure. The higher vapor pressure will afford a greater risk of room atmospheric contamination.

c. Chemical Characteristics. Where mixtures are involved, those with organic chemicals of the "aromatic" nature are generally more toxic (and often possess greater fire and explosion hazards) than those classed as "aliphatic" chemicals. Among the chemical characteristics which must be considered are stability, reactivity with other chemicals (for example, is the material an oxidizer or corrosive), and solubility (not only in water, but in other media).

d. Circumstances of Exposure. In addition to work area considerations, questions on the distribution of material throughout the weapon system life cycle or

a shore activity need to be considered. Localized use of a highly hazardous material (in a single work area) presents a different set of concerns when arriving at approval decisions than those that apply to one with moderate hazard potential which is widely used. Elements to be examined are: work force size or number of persons at a work site; present and/or needed engineering or other controls; and work area environmental conditions which affect the hazard (temperature, humidity, other chemicals which may be synergistic or additive, etc.). (Note: for new system acquisitions, data on work force size may be minimal or available only by comparing existing analogous naval weapon systems.)

When evaluating a material, weigh its interaction with other approved materials, its use in the system or work areas, and its interaction with nearby operations. For example, it would be a mistake to approve a new cleaning solvent with a high vapor pressure and low flash point for use in shops in which arc welding is performed.

e. Environmental Implications. The potential for HW generation and compliance with various Federal, State, and local codes, standards, and regulations must be evaluated. In some geographical areas, regulations on use and/or release of volatile organic compound air pollutants are very severe and may require special controls, if a material is approved. Similar concerns must be examined regarding air quality and water permits. More detailed ratings may have to be developed for some analyses.

4.2.3 Documentation of Analyses

Potential civil and criminal liability associated with HM use demands complete documentation of the decision process. As stated earlier, the substitution algorithm is only one element in the military decision process. If there is no alternative available for the required HM, its use must be documented and certain components addressed. Necessary control measures for protecting both personnel and the environment must be provided and approvals for using high and serious risk materials must be obtained. Documentation, appropriate for the magnitude of the possible impacts, must be developed and maintained on file.

4.3 PREPARATION FOR THE ANALYSES

Before using the algorithm to analyze two or more hazardous materials, the user should:

a. Obtain input data for each candidate material--one source is the MSDS from HMIS or for materials not in HMIS, from the manufacturer. The EPA "Title III, List of Lists" (EPA publication 560/4-90-011, Jan. 1990), available in hard copy and disk formats from EPA, contains information on several algorithm elements for the Environmental Impact Evaluation. The user should also consult State and local environmental regulatory requirements. Assistance can be obtained from the EPA Regional Offices (Federal Facilities Office) which are listed in Appendix B of OPNAVINST 5090.1A.

For existing operations and processes, data on work force size, operational procedures, and existing controls (or lack of) should be available. Technical/maintenance manuals are also important sources. For a system acquisition, possible changes in circumstances in each development/ acquisition phase must be identified and details obtained from the PM. In cases where analyses will be conducted by the system contractor, both production and later operational conditions must be taken into account.

b. Be aware that at different times in a material's life cycle exposed populations may vary in size, thereby creating differences in the various rating elements.

c. Identify needed control measures and precautionary procedures for the HM and document the rationale for selecting and approving high and serious risks.

4.4 OVERALL HAZARDOUS MATERIAL SUBSTITUTION PROCESS

Appendix C is an excerpt from the "Coordinated Navy Hazardous Material Substitution Manual" (Chapter 3) and includes references to Chapters in the Manual that are pertinent to the substitution approach presented in this "integrated" Manual.

Appendix C presents a generic HM substitution process which can serve as a basis for a common approach for HM substitution actions by Echelon II Commands and Acquisition Program Managers. The basic element descriptors should be tailored to allow for specific organizational differences provided that the basic approaches are followed.

Figure C-1 isa generic logic diagram for HM substitution procedures and different "paths" that may result in applying the process chart to specific substitution problems. Although primarily directed at material substitution, the basic principles and processes depicted in Appendix C are also applicable to "process" changes.

4.5 APPLYING THE SUBSTITUTION ALGORITHM

The substitution algorithm uses the following step-by-step procedure for comparing the relative hazards of candidate materials, one of which may be an existing HM on the approved AUL. Examples of using the worksheets are provided on the following pages along with a substitution algorithm worksheet.

SUBSTITUTION ALGORITHM

STEP 1. INFORMATION NEEDED FOR ANALYSES

A. Guidance Manual For Selection/Substitution of Less Hazardous Materials
B. Latest MSDS for candidate material
C. Work hours data
D. Number of personnel potentially exposed
E. NIOSH POCKET GUIDE TO CHEMICAL HAZARDS
F. EPA "TITLE III, LIST OF LISTS" OR 40 CFR 302.4
G. Air Toxics List of Hazardous Air Pollutants
H. State Environmental Requirements (VOC LISTS, ETC.)
I. PEL List from OSHA/29 CFR 1910.1000
J. TLV List from ACGIH
K. "Hazardous Materials User's Guide"/OPNAV P-45-110-91

STEP 2. HEALTH HAZARD SEVERITY CLASSIFICATION (HHSC)

A. EXPOSURE RESTRICTIONS

- Use the lowest listed PEL* or TLV** value for the material being evaluated.

- For materials with a time weighted average (TWA) given only in parts per million (ppm) or in both ppm and milligrams per cubic meter (mg/m^3), only use the value given in parts per million with Table 2A.1 to determine the points awarded for exposure restrictions.

- For materials with a TWA given only in mg/m^3, only use the value given in mg/m^3 with Table 2A.2 to determine the points awarded for exposure restrictions.

- When evaluating mixtures select the component with the lowest listed PEL or TLV value. Use this value to determine the points awarded for exposure restrictions.

- Note for mixture evaluation only: If the lowest PEL or TLV is given in mg/m^3, evaluate the mixture twice, once using the (lowest) listed mg/m^3 value and once using the lowest listed ppm value. Award this mixture the higher point value for exposure restrictions.

* Permissible Exposure Limit – 29 CFR 1910.1000
** Threshold Limit Value – American Conference of Governmental Industrial Hygienists (ACGIH)

TABLE 2A.1

Parts Per Million (PPM)	Points
0 to 100	8
101 to 175	7
176 to 250	6
251 to 335	5
336 to 417	4
418 to 500	3
501 to 1000	2
> 1000	1

TABLE 2A.2

Milligrams per Cubic Meter (mg/m^3)	Points
0.00 to 0.5	8
0.51 to 2.0	7
2.01 to 3.5	6
3.51 to 5.0	5
5.01 to 7.0	4
7.01 to 8.0	3
8.01 to 10.0	2
> 10.0	1

B. MEDICAL EFFECTS

Condition*	Points
1. No medical effect, such as nuisance noise and nuisance odor	0
2. Temporary reversible illness requiring supportive treatment, such as eye irritation and sore throat	2
3. Temporary reversible illness with a variable but limited period of disability, such as metal fume fever	4

* Consult the NIOSH Pocket Guide to Chemical Hazards to determine the medical effects of the MSDS's ingredient list. The MSDS health hazard data may lead to inaccurate results.

4. Permanent, non-severe illness or loss of capacity, such as permanent eye damage 6

5. Permanent, severe, disabling, irreversible illness or death, such as asbestosis and lung cancer 8

C. DETERMINE HHSC POINTS AND CATEGORY

Total A & B Points	Resulting Code
13-16	I
09-12	II
05-08	III
00-04	IV

STEP 3. ESTABLISH MISHAP PROBABILITY CODE (MPC)

A. LENGTH OF EXPOSURE TIME

Type of Work/Exposure	Points Based On Length of Exposure (hours/week)		
	1-8 Hours	>8 Hours (not continuous)	Continuous
Irregular, Intermittent	2	5	NA
Regular, Periodic	3	6	8

B. NUMBER OF PERSONS POTENTIALLY EXPOSED

Persons	Points
1 - 2	1
3 - 5	2
6 - 7	3
8 - 9	4
10 -22	5
23 -35	6
36 -49	7
>49	8

C. DETERMINE MPC POINTS AND CATEGORY

(Sum of Step A & B Points)	Category
14 -16	A
10 -13	B
6 - 9	C
0 - 5	D

STEP 4. RAC DEVELOPMENT

A. HHSC CATEGORY FROM STEP 2C

B. MPC CATEGORY FROM STEP 3C

C. DETERMINE RAC NUMBER FROM FIGURE 4-5

RAC 1 = HIGH RISK
RAC 2 = SERIOUS RISK

STEP 5. FLAMMABLE/COMBUSTIBLE LIQUIDS EVALUATION

A. DETERMINE FLASH POINT AND BOILING POINT TEMPERATURES IN DEGREES FAHRENHEIT

FLAMMABLE LIQUIDS °F (°C) ≤141°F (61°C)

Flash Point (FP)	Boiling Point (BP)	Points
Below 73 (23°C)	Below 100 (38°C)	10
Below 73 (23°C)	At/above 100 (38°C)	9
At/above 73 (23°C) and Below 100 (38°C)		8

COMBUSTIBLE LIQUIDS °F (°C) >141°F (61°C) ≤200°F (93°C)

Flash Point (FP) At or Above	Flash Point (FP) and Below	Points
142 (61°C)	170 (77°C)	6
170 (77°C)	200 (93°C)	4
200 (93°C)	—	2

B. FLAMMABLE/COMBUSTIBLE LIQUIDS POINTS

FIGURE 4 - 5

Determine RAC Using Matrix, enter at HHSC and Correlate with MPC

Mishap Probability (MPC)

		A	B	C	D
Hazard Severity (HHSC)	I	1	1	2	3
	II	1	2	3	4
	III	2	3	4	5
	IV	3	4	5	5

Note: Interpretation of HM Selection Risk Assessment Code

RAC 1 = High Risk (Imminent danger to life or property; possible civil or criminal action)

RAC 2 = Serious Risk (May result in severe injury or illness on or off site, potential for major damage to environment and resulting notice of violation)

RAC 3 = Moderate Risk (May cause few illnesses or injuries or significant property damage or environment impact on or off site)

RAC 4 = Low Risk (Can result in only minor impact on or off site or only violation of a standard without damage)

RAC 5 = Negligible (Insignificant impacts)

STEP 6. PERSONAL PROTECTIVE EQUIPMENT (PPE) EVALUATION

A. DETERMINE PPE REQUIREMENTS

Sources:

1. The most current "NIOSH Pocket Guide to Chemical Hazards," DHHS (NIOSH) Publication No. 90-117.
2. MSDS
3. "Hazardous Material User's Guide," OPNAV P-45-110-91
4. Medical and/or Safety professional assistance

B. DETERMINE PPE POINTS

PPE REQUIREMENTS	POINTS
1. Either faceshield, gloves, apron, or booties (one point skin protection)	1
2. One or more combination of faceshield, gloves, apron, or booties (multiple point skin protection)	2
3. Goggles (eye protection)	3
4. Combination of goggles and gloves, apron, or booties (eye and skin protection)	4
5. Cartridge/canister respirator one-half facepiece for gas, vapor, and/or particulate contamination (respiratory protection)	5
6. Cartridge/canister respirator full facepiece for gas, vapor, and/or particulate contamination (respiratory and eye protection)	6
7. Combination of cartridge/canister respirator full facepiece for gas, vapor, and/or particulate contamination and gloves, apron, and/or booties (respiratory, eye, and skin protection)	7
8. Supplied air respirator or self contained breathing apparatus (respiratory and eye protection)	8

9. Combination of supplied air respirator or self contained breathing apparatus and gloves, apron, and/or booties (respiratory, eye, and skin protection) 9

10. Supplied air respirator or self contained breathing apparatus and full impervious suit (complete protection) 10

STEP 7. VOLATILE ORGANIC COMPOUND (VOC) EVALUATION

A. DETERMINE CHEMICAL VAPOR PRESSURE (VP) AT 70 DEGREES F

B. DETERMINE VP POINTS

VAPOR PRESSURE (mm Hg @ 70° F)	POINTS
201 and Higher	15
101 to 200	12
91 to 100	10
81 to 90	9
71 to 80	8
61 to 70	7
51 to 60	6
41 to 50	5
31 to 40	4
21 to 30	3
11 to 20	2
1 to 10	1
BELOW 1	0

STEP 8. ENVIRONMENTAL IMPACT EVALUATION

Environmental Attributes	Points

(Note: Consider each attribute a separate item of evaluation. A total of 34 points can be attained from A through F.)

A. New Hazard Potential – Material results in a changed hazard potential (fire hazard, change in media (e.g., air pollutant to solid waste, etc.)). Assess points against candidate material exhibiting worst hazard. 10

B. EPA/State Bad Actor Lists -- Material is on EPA Priority Pollutant list, Air Toxics List, EPA or State list of volatile organic compounds (VOC), ozone depleters, etc. 8

C. Environmental Impact Statement (EIS) -- Projected use requires EIS 6

D. FEDERAL/STATE Permits -- Projected use involves air or water quality permit, or State Implementation Plan requirements, etc. 4

E. MILCON PROJECT -- Projected use requires hazard control facilities and equipment, with military construction (MILCON) in excess of $200,000 4

F. Environmental Assessment (EA) -- Projected use requires an EA 2

G. REPORTABLE QUANTITIES POINTS -- Evaluate materials listed on EPA's "List of Hazardous Substances and Reportable Quantities (RQ)" (40 CFR 302.4) (See Figure 4-6 for example) or EPA's "TITLE III, List of Lists" (RQ columns)

1. DETERMINE REPORTABLE QUANTITIES CODE

2. DETERMINE REPORTABLE QUANTITIES POINTS

Table 302.4 Final RQ Category	Points
X (1# or less)	10
A (1# to 10#)	8
B (10# to 100#)	6
C (100# to 1000#)	4
D (1000 to 5000#)	2
Not on list	0

H. CLEAN AIR ACT Permissible Emission -- Evaluate EPA Clean Air Act Permissible Emission Rates for Material (40 CFR 52.21(b)(23)) (See Figure 4-7 for example)

1. DETERMINE TONS PER YEAR OF AIR EMISSIONS

2. DETERMINE AIR EMISSIONS POINTS

Allowable Tons Per Year	Points
7 or less	10
8 - 25	8
26 - 40	6
41 - 100	4
> 100	2
Not on list	0

I. SUM TOTAL A THROUGH H POINTS

STEP 9. DEVELOP HAZARDOUS MATERIAL SELECTION FACTOR (HMSF)

A. ADD TOTAL POINTS FROM STEPS 2C, 3C, 5B, 6C, 7B, AND 8I. THIS IS THE NUMERICAL HMSF FOR THIS CANDIDATE MATERIAL

STEP 10. MATERIAL SELECTION RECOMMENDATION

A. LIST RAC FOR CANDIDATE MATERIAL (FROM STEP 4C)

B. LIST HMSF FOR CANDIDATE MATERIAL (FROM STEP 9A)

C. FROM THE CANDIDATES, RECOMMEND THE HAZARDOUS MATERIAL WITH THE LOWEST HMSF AND RAC NUMBER OF 2 OR HIGHER. (NOTE: THE HIGHER THE HMSF, THE HIGHER THE ENVIRONMENTAL, HEALTH, AND SAFETY RISK.)

FIGURE 4 - 6

TABLE 302.4 - LIST OF HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES

Hazardous Substance	CASRN	Regulatory Synonyms	Statutory			Final RQ	
			RQ	Code	RCRA Waste Number	Category	Pounds (Kg)
Acenaphthene...	83329	.....	1*	2	.....	B	100(45.4)
Acenaphthylene...	208968	.....	1*	2	.....	D	5000 (2270)
Acetaldehyde...	75070	Ethanal...	1000	1,4	U001	C	1000 (454)
Acetaldehyde, chloro...	107200	Chloroacet-aldehyde...	1*	4	P023	C	1000 (454)
Acetaldehyde, trichloro...	75876	Chloral...	1*	4	UO34	X	1#(0.454)
Acetamide, N-(aminothioxomethyl)-...	591082	1-Acetyl-2-thiourea...	1*	4	P002	C	1000 (454)
Acetamide, N-(4-ethoxyphenyl)-...	62442	Phenacetin...	1*	4	U187	X	1#(0.454)
Acetamide, N-9H-fluoren-2-yl-.	53963	2-Acetylamino-fluorene...	1*	4	U005	X	1#(0.454)
Acetamide, 2-fluoro-...	640197	Fluoroaceta-mide...	1*	4	P057	B	100 (45.4)
Acetic acid...	64197	.....	1000	1	.....	D	5000 (2270)

FIGURE 4 - 7

"SIGNIFICANT" POLLUTANT EMISSION RATES

Pollutant	Emission Rate (tons/year)
Carbon monoxide (CO)	100
Nitrogen oxides (NO_x)	40
Sulfur dioxide (SO_2)	40
Particulate matter	25
Ozone	40*
Lead	0.6
Asbestos	0.007
Beryllium	0.0004
Mercury	0.1
Vinyl chloride	1
Fluorides	3
Sulfuric acid mist	7
Hydrogen sulfide (H_2S)	10
Total reduced sulfur (including H_2S)	10
Reduced sulfur compounds (including H_2S)	10
Any other pollutant	Any amount

* 40 tons per year of volatile organic compounds.

Source: 40 CFR 52.21(b)(23)(i-ii)

SUBSTITUTION ALGORITHM WORKSHEET

ALGORITHM STEP	CHEMICAL A	CHEMICAL B	UNITS
1. A. Chemical			
B. On AUL?			
C. Operational Uses			
2. Health Hazard Severity Classification (HHSC)			
A. Exposure Restrictions			Points
B. Medical Effects			Points
C. HHSC - Points (2A+2B)			Points
- Category			Code
3. Mishap Probability Code (MPC)			
A. Length of Exposure			Points
B. Persons Exposed			Points
C. MPC - Points (3A+3B)			Points
- Category			
4. Risk Assessment Code (RAC)			
A. HHSC Category (2C)			
B. MPC Category (3C)			
C. RAC (Figure A-1)			RAC -
5. Flammable/Combustible Liquids			
A. Flash Point (FP)			°F/°C
Boiling Point (BP)			°F/°C
B. Flammable/Combustible			Points
6. Personal Protective Equipment (PPE)			
A. PPE Requirements			
B. PPE			Points

ALGORITHM STEP	CHEMICAL A	CHEMICAL B	UNITS
7. Volatile Organic Compounds (VOC)			
A. Vapor Pressure (VP)			mm Hg
B. VP			Points
8. Environmental Impact Attributes			
A. New Hazard Potential			Points
B. EPA/State Bad Actor Lists			Points
C. Environmental Impact Statement (EIS)			Points
D. Federal/State Permits			Points
E. MILCON Project			Points
F. Environmental Assessment (EA)			Points
G. Reportable Quantities (RQ)			
1. RQ Code			Code
2. RQ			Points
H. Permissible Emissions			
1. Air Emissions			Tons/yr
2. Air Emissions			Points
I. Sum Points A through H			Points
9. Hazardous Material Selection Factor (HMSF)			
A. HMSF (2C+3C+5B+6B+7B+8I)			Points
10. Material Selection Recommendation			
A. RAC (4C)			RAC
B. HMSF (9A)			Points
C. Recommended Material RAC>2 & Lowest HMSF			

EXAMPLE SCENARIO 1
COMPARISON OF TWO INDUSTRIAL DEGREASERS
P-D-680, TY II VS. CANDIDATE CHEMICAL

Chemical A

MSDS for P-D-680, TY II*

FSN: 6859-00-110-4498
Manufacturer's Name: Magnaflux Surface Conditioners, Inc.
Manufacturer's CAGE: 60672
Date MSDS Prepared: *** PRE-HCS
HMIS MSDS Serial Number: BCYYP

Chemical B

MSDS for CANDIDATE CHEMICAL

FSN: XXXX-XX-XXX-XXXX
Manufacturer's Name: XXXXXX
Manufacturer's CAGE: XXXXX
Date MSDS Prepared: 01 Feb 90
HMIS MDSD Serial Number: XXXXX

Work/Exposure Conditions**

Length of Exposure: 1-8 Hours/Week

Type of Work/Exposure: Irregular, Intermittent

Number of Persons Potentially Exposed: 38

* MSDS information taken from HMIS System
** For the purpose of this scenario, work/exposure conditions for Chemical A and Chemical B are considered similar.

SUBSTITUTION ALGORITHM WORKSHEET

ALGORITHM STEP	CHEMICAL A	CHEMICAL B	UNITS
1. A. Chemical	P-D-180	CANDIDATE CHEMICAL	
B. On AUL?	Yes	No	
C. Operational Uses	Degreaser	Degreaser	
2. Health Hazard Severity Classification (HHSC)			
A. Exposure Restrictions	3	3	Points
B. Medical Effects	4	4	Points
C. HHSC - Points (2A+2B)	7	7	Points
- Category	III	III	Code
3. Mishap Probability Code (MPC)			
A. Length of Exposure	2	2	Points
B. Persons Exposed	7	7	Points
C. MPC - Points (3A+3B)	9	9	Points
- Category	C	C	
4. Risk Assessment Code (RAC)			
A. HHSC Category (2C)	III	III	
B. MPC Category (3C)	C	C	
C. RAC (Figure A-1)	4	4	RAC
5. Flammable/Combustible Liquids			
A. Flash Point (FP)	140/60	215/102	°F/°C
Boiling Point (BP)	355/179	450/232	°F/°C
B. Flammable/Combustible	4	2	Points
6. Personal Protective Equipment (PPE)			
A. PPE Requirements	Glasses & Gloves	Glasses	
B. PPE	4	1	Points

ALGORITHM STEP	CHEMICAL A	CHEMICAL B	UNITS
7. Volatile Organic Compounds (VOC)			
A. Vapor Pressure (VP)	10	0.33	mm Hg
B. VP	1	0	Points
8. Environmental Impact Attributes			
A. New Hazard Potential	10	0	Points
B. EPA/State Bad Actor Lists	0	0	Points
C. Environmental Impact Statement (EIS)	0	0	Points
D. Federal/State Permits	4	0	Points
E. MILCON Project	0	0	Points
F. Environmental Assessment (EA)	0	0	Points
G. Reportable Quantities (RQ)			
1. RQ Code	D	D	Code
2. RQ	2	2	Points
H. Permissible Emissions			
1. Air Emissions	40 (VOC)	Unlisted	Tons/yr
2. Air Emissions	6	0	Points
I. Sum Points A through H	22	2	Points
9. Hazardous Material Selection Factor (HMSF)			
A. HMSF (2C+3C+5B+6B+7B+8I)	47	21	Points
10. Material Selection Recommendation			
A. RAC (4C)	4	4	RAC
B. HMSF (9A)	47	21	Points
C. Recommended Material RAC>2 & Lowest HMSF	CANDIDATE CHEMICAL		

EXAMPLE SCENARIO 2
COMPARISON OF TWO INDUSTRIAL CLEANERS
FREON 113 VS. CANDIDATE CHEMICAL

Chemical A

MSDS for FREON 113*

FSN: 6850-00-D00-1025
Manufacturer's Name: Hach Company
Manufacturer's CAGE: 91224
Date MSDS Prepared: *** 12 Mar 86
HMIS MSDS Serial Number: BBDSK

Chemical B

MSDS for CANDIDATE CHEMICAL

FSN: XXXX-XX-XXX-XXXX
Manufacturer's Name: XXXXXXXX
Manufacturer's CAGE: XXXXX
Date MSDS Prepared: *** 01 Feb 90
HMIS MSDS Serial Number: XXXXX

Work/Exposure Conditions**

Length of Exposure: 1-8 Hours/Week

Type of Work/Exposure: Irregular, Intermittent

Number of Persons Potentially Exposed: 38

* MSDS information taken from HMIS System
** For the purpose of this scenario, work/exposure conditions for Chemical A and Chemical B are considered similar.
*** Contact the manufacturer for the latest version of the MSDS for this product before proceeding with the evaluation.

SUBSTITUTION ALGORITHM WORKSHEET

ALGORITHM STEP	CHEMICAL A	CHEMICAL B	UNITS
1. A. Chemical	FREON 113	CANDIDATE CHEMICAL	
B. On AUL?	Yes	No	
C. Operational Uses	Cleaner	Cleaner	
2. Health Hazard Severity Classification (HHSC)			
A. Exposure Restrictions	2	3	Points
B. Medical Effects	4	4	Points
C. HHSC - Points (2A+2B)	6	7	Points
- Category	III	III	Code
3. Mishap Probability Code (MPC)			
A. Length of Exposure	2	2	Points
B. Persons Exposed	7	7	Points
C. MPC - Points (3A+3B)	9	9	Points
- Category	C	C	
4. Risk Assessment Code (RAC)			
A. HHSC Category (2C)	III	III	
B. MPC Category (3C)	C	C	
C. RAC (Figure A-1)	4	4	RAC
5. Flammable/Combustible Liquids			
A. Flash Point (FP)	N/R	215/102	°F/°C
Boiling Point (BP)	118/48	450/232	°F/°C
B. Flammable/Combustible	0	2	Points
6. Personal Protective Equipment (PPE)			
A. PPE Requirements	SCBA & Goggles & Gloves	Glasses	
B. PPE	9	1	Points

ALGORITHM STEP	CHEMICAL A	CHEMICAL B	UNITS
7. Volatile Organic Compounds (VOC)			
A. Vapor Pressure (VP)	334	0.33	mm Hg
B. VP	15	0	Points
8. Environmental Impact Attributes			
A. New Hazard Potential	0	0	Points
B. EPA/State Bad Actor Lists	8	0	Points
C. Environmental Impact Statement (EIS)	0	0	Points
D. Federal/State Permits	4	0	Points
E. MILCON Project	0	0	Points
F. Environmental Assessment (EA)	0	0	Points
G. Reportable Quantities (RQ)			
1. RQ Code	Unlisted	D	Code
2. RQ	0	2	Points
H. Permissible Emissions			
1. Air Emissions	40 (VOC)	Unlisted	Tons/yr
2. Air Emissions	6	0	Points
I. Sum Points A through H	18	2	Points
9. Hazardous Material Selection Factor (HMSF)			
A. HMSF (2C+3C+5B+6B+7B+8I)	57	21	Points
10. Material Selection Recommendation			
A. RAC (4C)	4	4	RAC
B. HMSF (9A)	57	21	Points
C. Recommended Material RAC>2 & Lowest HMSF	CANDIDATE CHEMICAL		

CHAPTER 5

ECONOMIC ANALYSES IN HAZARDOUS MATERIAL CONTROL AND MANAGEMENT DECISIONS

CHAPTER 5.0

"ECONOMIC ANALYSES IN HAZARDOUS MATERIAL CONTROL AND MANAGEMENT DECISIONS"

5.1 INTRODUCTION

The preferred approach to pollution prevention is source control. The preferred methods for achieving this control include substituting materials, modifying processes or operating procedures, redesigning components to eliminate HM or its manufacture, use or maintenance, and recycling/reusing HM. In accordance with OPNAVINST 4110.2 and DoDD 4210.15, PMs must select, use, and manage HM over its life cycle to ensure that DoD protects human health and the environment, while incurring the lowest costs.

Eliminating HM or reducing its use would generally offer the most significant reduction in potential hazards to human health and the environment. When considering pollution prevention alternatives, a reduction in the hazardous nature of materials used and the mass of HW generated should be given utmost consideration. A complete economic analysis, performed in accordance with SECNAVINST 7000.14B, is a required input to making proper decisions for the use of resources.

This Chapter describes a framework for applying economic analysis to HM management issues. The discussion focuses on a set of proposed life cycle cost procedures for evaluating and selecting HM and less-hazardous substitute materials for use in weapon systems and/or related processes. The approach presented here allows the user to prioritize the most hazardous materials based on hazardous characteristics and volume of HW generation.

The overall economic analysis model, shown later in Figures 5-1 through 5-3, consists of systematic steps: 1) to determine the most significant HM in terms of characteristics and types/amounts of wastes generated; 2) to identify pollution prevention alternatives, ranging from material substitution or system modification to recycling or regeneration; and 3) to evaluate each alternative in terms of implementation costs and other intangible factors to determine the most beneficial alternative.

The approach utilizes the concept of progressively and systematically eliminating the less critical HM in a timely and cost-effective manner so that major resources can be focused on materials that have the greatest impacts on human health, the environment, and cost. While generic in nature, the approach is both flexible and consistent and could be applied to a weapon system, a HM, or any process necessary to support a weapon system. Given this methodology, the user has a tool for identifying critical cost factors associated with HMC&M issues, particularly when implementing pollution prevention alternatives. Table 5.1 shows the steps incorporated into the model.

TABLE 5.1 - APPROACH SUMMARY

STEP	PURPOSE
1	Defines system/scope for analysis.
2	Identification of applicable life cycle phases.
3	Identification of the system/process material requirements.
4	Identification of any previously evaluated materials, products, or processes.
5	Identification of material/product characteristics-data collection.
6	Determination of the level of potential hazard associated with each material or product.
7	Identification of processes ranking information for materials/products according to their level of hazard.
8	Determination of process rank based on the relative level of hazard of materials/products used in the process.
9	Identification of pollution prevention alternatives.
10	Determination of the level of hazard associated with a proposed substitute material/product.
11	Determination of prioritization factors for material/product substitution alternatives.
12	Identification of system modification pollution prevention alternatives.
13	Identification of regeneration/recycling pollution prevention alternatives.
14	Identification of equipment/operational changes required for each pollution prevention alternatives.
15	Determination of incremental costs for each alternative and the applicable life cycle phases and cost factors.
16	Identification of intangible (non-cost) factors associated with each alternative.
17	Determination of the hazardous waste reduction potential of each alternative.
18	Summarizes information for each alternative including incremental costs, non-cost factors, and hazardous waste reduction potential. Allow for direct comparison of alternatives.

5.1.1 The Role of Economic Analysis and DoD

The DoD, Military Departments, and other components have established pollution prevention programs. But, the role of economic analyses in these programs varies from department to department. While all departments and components must utilize life cycle cost (LCC) models when evaluating weapon systems and subsystems in accordance with DoDI 5000.2, the specific use of LCC models concerning HM control issues has only been established in a few cases.

The economic analysis models prepared to date by the Military Departments are, in general, site or system specific; as a result, they cannot be directly applied to meeting the Navy's HM management needs. Certain features in other models (e.g., CERL, USAF LCC), however, have been identified as practicable for use with the proposed Navy economic analysis method, when combined with a more universal framework.

5.1.2 Economic Analysis and Pollution Prevention Activities

A study to develop economic analyses of pollution prevention activities was conducted for the Navy, in accordance with OPNAVINST 4110.2. As this Chapter demonstrates, economic analysis, which is a systematic, iterative procedure for evaluating and ranking alternatives which meet an objective, offers an approach to applying the elements of life cycle costs (LCCs) and benefit implications to HMC&M alternatives. Selected results from the models described above have been incorporated into the proposed methodology. The resulting model comprises an initial screening mechanism, a preliminary LCC analysis, and a detailed cost analysis. While this economic analysis model is a useful tool, it may require further development and refinement in order to meet OPNAVINST 4110.2 requirements for identifying and evaluating LCCs associated with feasible HMC&M alternatives during the acquisition process.

5.1.3 The Scope Of HMC&M Economic Analysis

The proposed economic analysis approach is for use by PMs and other designated personnel when making HM substitutions or other modifications associated with a process or particular weapon system. Support contractors may also be required to use this approach. A multidisciplinary group including material, process and design engineers, safety personnel, and industrial hygienists, may be involved (prior to LCC estimation) in determining the suitability of weapon system materials.

To ensure early HMC&M compliance during the acquisition process, PMs will have to obtain information on R&D, LCC, and health and environmental risks for the HM to be used. One suggested approach is to require contractors to provide cost information concerning HM as designated in MIL-STD-1388-1A and 1388-2B.

To use any LCC model, the user will also need access to or knowledge of HM/HW data for all system acquisition phases. The incremental costs will be key

factors in determining the LCC input to the overall HM decision process. PMs must determine any significant cost differences (i.e., "cost drivers") between two materials or systems. Cost differences could exist for a number of different HM cost factors including:

- Procurement
- Transportation
- Handling
- Training
- PPE
- Legal/Environmental
- Medical
- Facilities
- Support Equipment
- Management
- Disposal

Familiarity with cost factors, industrial processes, similar classes of weapon systems, and groups of HM and their properties, should save considerable time in the decision-making process. Conducting a sensitivity analysis may also result in a much simplified process (e.g., where relatively few cost drivers must be evaluated).

The suggested approach includes an initial, qualitative ranking and screening process, followed by a preliminary cost evaluation and a more detailed cost evaluation, if applicable. The preliminary cost evaluation presented here is not intended to be an economic analysis which incorporates every cost factor in detail nor is it intended to produce a detailed cost estimate. Rather, the approach is intended to aid the user in identifying "clear choice" alternatives or making initial, preliminary decisions about which alternatives, if any, require more detailed evaluation.

The initial screening is accomplished using the approach described later in Section 5.3.1, Level I - Screening and Ranking HM. HM identified in the initial screening are then prioritized on the basis of chemical/physical properties, quantities of HM, and resulting HW, prior to further evaluation. This process of prioritization conserves resources by evaluating the most significant HM first.

In Level II, the qualitative screening process reduces the number of potential pollution prevention alternatives evaluated for each material or process (Section 5.3.2). Based on the qualitative screening, the user can then determine which HM and applicable pollution prevention alternatives should undergo a cost evaluation.

The preliminary cost evaluation would be used for those alternatives that are expected to result in reduced HM use and HW generation. The difference between the LCCs for each pollution prevention alternative and the existing or base condition would be determined during this evaluation. A preliminary review of intangible factors for each alternative is performed once a comparison is completed. Where a clear choice between alternatives or an existing base process can be made, the analysis is completed for those alternatives and the selected choice is implemented. A more detailed evaluation is recommended where costs and/or intangible factors do not indicate a clear choice.

If no clear choice is evident after the preliminary evaluation, then a detailed evaluation using quantitative methods may be necessary. The detailed cost evaluation should only consider the most sensitive

cost factors and may require a data collection effort.

This sequential approach to economic analysis, which employs an analytical tool that is appropriate for the level of analysis required, will allow the user to begin an evaluation at any step in the process (depending on the system and available information). The different degrees of evaluation presented in this approach are consistent with the level of effort requirements in DoDD 4210.15.

5.1.4 Limitations of the Proposed Economic Analysis

The proposed economic analysis approach is designed to rank HM in a systematic, timely, and cost-effective manner by assessing potential risks and consequences associated with their use. The user can then identify pollution prevention alternatives and associated cost factors to evaluate in the preliminary and the more detailed LCC analysis. Using output from this analysis, the user can make informed decisions on the benefits and costs associated with each pollution prevention alternative, before recommending or selecting the alternative or the base materials for system use.

Because the approach is flexible, it can be modified to accommodate changes identified during further verification, validation and testing. (To date, the economic analysis model has been field tested at the Philadelphia Naval Shipyard on a paint stripping process).

In view of its generic form, the approach can be applied to a wide range of HM, industrial processes and weapon systems. However, the approach is neither an "expert" system nor a stochastic approach which allows the user to select an uncertainty range around the best estimate for a given cost factor to then calculate probability distributions of cash flows.

The proposed model does not include any sensitivity analyses or analysis of "what if" situations. A sensitivity analysis could be performed to simplify the analysis by looking at changes in the solution due to discrete parameter changes. This could be accomplished by establishing several input conditions that can be run separately and then compared, provided they are clearly defined.

The following conclusions resulted from the development of the economic analysis model:

- All significant costs over the entire system life cycle, process, or material must include an economic analysis of pollution prevention alternatives.
- Economic analyses may be significantly simplified by focusing on the cost differential between potential alternatives and the existing baseline.
- Screening mechanisms may enhance the economic analysis approach by sorting out alternatives that are either "obvious" or are clearly not feasible. Obvious alternatives are those that significantly reduce hazardous waste generation at minimal cost and do not affect mission criteria.

- Key inputs to economic analysis include using factors from the HM selection/substitution methodology for considering the hazardous nature of materials being evaluated.

- Additional analysis of Navy operations should be conducted to develop an appropriate database to calibrate and validate the proposed economic analysis.

As stated earlier, economic analysis alone is only one input to the decision-making process. The decision-maker must interpret economic analysis results with other intangible factors such as safety, health, morale, environmental impacts and other constraints involved in the total decision process.

5.2 ECONOMIC FACTORS IN HMC&M DECISIONS

Alternatives for HM decisions must be evaluated using an economic analysis to establish the basis for selecting the least hazardous material at the lowest possible cost to protect human health and the environment. The analytical approach used must be commensurate with the importance of the decision being made. Analyses must begin as early as possible in the life cycle of the system under consideration.

5.2.1 Life Cycle Cost Phases

As presented previously in Chapter 3, the distinct life cycle phases of a weapon system established under DoDI 5000.2 include: Phase 0 - Concept Exploration and Development; Phase 1 - Demonstration and Validation; Phase 2 - Engineering and Manufacturing Development; Phase 3 - Production and Deployment; and, Phase 4 - Operation and Support. An additional phase would include Phase 5 - Decommissioning, Demilitarization and Disposal. The following Section offers information on the economic factors to be considered during the various phases of a system acquisition.

5.2.2 Tangible Costs

The HM life cycle begins when HM use or potential use are first encountered and extends as long as any material or its waste products represent a cost to the Navy. LCC involve a number of factors that influence HM costs during different phases of a weapon system's life. The following section presents details on the role of cost factors in weapon system life cycle phases. Section 5.4.14 provides a more details on cost factors. (Please note that evaluation and planning for all the HM cost factors listed below takes place during Phases 0 and 1).

Engineering/Design Costs--this factor refers to all engineering efforts associated with system, process or equipment design and development, and includes the cost of systems engineering and integration, design engineering (structural, electrical, mechanical, construction, etc.), design support (reliability, maintainability, human factor engineering and safety, value engineering, etc.) and the redesign or formulation of engineering changes which would result from HM use. Costs incurred during the engineering process for direct labor, materials, other direct costs, computer software development and computer time should be included.

Procurement--costs to purchase HM used in producing, deploying, operating and supporting various Navy systems, affect the Navy, prime contractors, subcontractors and suppliers and should be evaluated in the proposed approach. HM procurement costs are involved in Phases 2-5 of the systems life cycle.

Transportation--during Phases 2-4, transportation costs include all personnel and equipment necessary to transport HM from point of arrival or storage to point used. Transporting the weapon system to its ultimate disposal location during Phase 5 is included in the disposal cost factor. Shipping costs from the manufacturer of HM would be incorporated as a procurement cost.

Handling--this cost deals with handling HM, including supply (distribution), storage, inventory control and labeling. This factor, which is mainly personnel costs (including lost productivity due to controls and restrictions caused by HM), influences costs in Phases 2-5. Equipment used for handling HM/HW is included in the support equipment cost factor.

Training--these factors include OSHA HAZCOM, HM site workers, spill response, first aid, and other training. The training costs include intensive training sessions, annual refresher courses, and personnel costs for the trainers/trainees. Training for HM/HW use and handling may be required in Phases 2-5.

Personal Protective Equipment--the PPE factor includes costs to procure, maintain and distribute equipment and any lost productivity due to reduced efficiency. PPE includes respirators, gloves, body suits, goggles and boots, etc. PPE, which may be required in Phases 2-5, includes engineering controls used to protect personnel from health hazards and HW. Such costs are included in the facilities cost factor.

Legal and Environmental--costs associated with HM use and HW disposal include lawsuits, regulatory authority correspondence, real property damage and contaminated air, soil and water (groundwater and surface water) treatment. Legal and environmental costs, which vary with country, state and local regulations, encompass all weapon system life cycle phases and the cost to bring Navy installations into compliance with current and future (pending or proposed) regulations.

Medical--this factor includes all medical costs (which may occur in Phases 2-5) associated with personnel physical examinations, surveillance, downtime due to illness/injury and industrial hygiene surveys. Surveillance includes costs for medical program record keeping and compliance with OSHA.

Facilities--this factor (part of Phases 2-5) includes costs to design, construct and maintain facilities where HM/HW are stored or used and engineering controls required in existing facilities.

Support Equipment--costs include the purchase, use and maintenance of equipment used to handle HM/HW. Support equipment used during Phases 2-5 can include laboratory equipment, recycling equipment, handling devices, spill response equipment, etc.

Management--this factor involves personnel costs for HM control and management during the system's life cycle including technical and administrative planning; organizing; directing; and coordinating actions designed to accomplish overall program objectives.

Disposal--this factor includes HW disposal costs (including expired shelf-life materials) and soils, sludge, sediments and groundwater contaminated by HM/HW. Costs include wastewater treatment, analytical costs for characterization and waste and contractor costs (including transportation) to dispose of HW off-site. Administrative costs for permitting, recordkeeping, etc. are included in the legal/environmental cost factor. HW disposal may occur during Phases 2-5.

HM costs incurred during Phases 2-5 are influenced by many of the same cost factors. The differences in the phases are the number of prototypes developed (Phase 2), units produced per year (Phase 3), units supported, economic life of the units, additional costs of unit maintenance (Phase 4) and the number of units requiring disposal (Phase 5). Table 5.2 summarizes the cost factors involved in each phase.

5.2.3 Intangible Factors

Intangible factors are described in DoD Directive 4210.15 as influences bearing on the use or effects of HM, which may not be reduced to monetary terms.

Intangible factors, which include quality of defense, quality of environment, public opinion and potential legislation, should have limited use in decision analysis but cannot always be totally eliminated. Although difficult to quantify, the consequences of intangible factors should be clearly identified and presented.

Intangible factors should be considered following the cost determination and HW reduction differential between pollution prevention alternatives or the baseline. All factors should be evaluated together at the end of the process to help determine the usefulness of the particular pollution prevention alternative.

5.2.4 Cost Drivers

Cost drivers are determined from tangible cost factors. Cost drivers, which are factors contributing a significant percentage to the total cost of HM, may vary among weapon systems, acquisition phases, and specific HM. Until a sensitivity analysis is performed, cost drivers are nearly impossible to identify. Once the proposed approach has been used for a number of Navy applications, cost drivers may be determined and the evaluation process simplified. For the purpose of this Manual, all cost factors are considered. During actual implementation, one or more cost factors may be eliminated.

5.3 THE HMC&M ECONOMIC ANALYSIS MODEL

The HMC&M economic analysis model has three distinct levels as shown in Figures 5-1 through 5-3:

- Level I - Screening and Ranking of Hazardous Materials

TABLE 5.2 - SUMMARY OF HAZARDOUS MATERIAL COST FACTORS IN EACH PHASE[a]

Cost Factor[b]	Weapon System Acquisition Phase
Engineering/Design	0, 1, 2, 3, 4, 5
Procurement	2, 3, 4
Transportation	2, 3, 4, 5
Handling	2, 3, 4, 5
Training	2, 3, 4, 5
PPE	2, 3, 4, 5
Legal/Environmental	0, 1, 2, 3, 4, 5
Medical	2, 3, 4, 5
Facilities	2, 3, 4, 5,
Support Equipment	2, 3, 4, 5
Management	0, 1, 2, 3, 4, 5
Disposal	2, 3, 4, 5

a = Weapon System Acquisition Phase

b = Planning and evaluation for all hazardous material control and management cost factors occur during Phases 0 and I.

- Level II - Identification of Pollution Prevention Alternatives to Address Level I Materials

- Level III - Economic Analysis of Pollution Prevention Alternatives

Level I (Figure 5-1) involves identifying material requirements and ranking the materials in terms of potential hazards and waste generated. If an alternative material (process or system) has already been identified, this level is unnecessary. Level I, qualitative in nature, is based on information related to the HM's physical, biological and chemical properties, and use and generation rates. Identifying materials that pose the greatest risk to human health and the environment (while making up a large percentage of the Navy's HW stream) is a significant objective of Level I.

Level II (Figure 5-2) identifies (for each HM or group of HM), pollution prevention alternatives to minimize or eliminate HM use and HW generation. Pollution prevention alternatives are separated into three categories: material substitution, system or process modification, or recycling/regeneration. The pollution prevention alternatives are evaluated in terms of reducing or eliminating HM use and HW production, while minimizing the adverse impacts on system performance and achieving system objectives.

Level III (Figure 5-3) is an economic analysis and overall evaluation of the proposed pollution prevention alternative(s). The economic analysis includes a LCC analysis based on incremental costs associated with implementing pollution prevention alternatives relative to the HM proposed or in use. When performing the LCC analysis, all cost factors associated with HM use and implementation of alternatives are identified. Preliminary estimates of incremental costs are determined, based on previous experience and historical cost data.

Once the LCC analysis is completed, non-cost (intangible) factors such as quality of environment, public opinion and potential legislation should be considered. The pollution prevention alternatives are evaluated in terms of incremental costs, consequences of intangible factors and hazard/waste reduction potential to determine if a clear choice alternative may be identified or if no alternative should be implemented. If two or more alternatives are favorable, but the preliminary analysis does not provide enough detail to make a choice, a more detailed evaluation should be conducted for those alternatives. The results of this detailed evaluation will provide the user with a sound basis for selecting the most desirable alternative.

5.3.1 Level I - Ranking of Hazardous Materials

Level I, which provides a systematic procedure for ranking HM for further analysis, involves reviewing system requirements and evaluating and ranking HM/HW. If this information has already been obtained, the user should move immediately to Level II.

FIGURE 5 - 1
ECONOMIC ANALYSIS OF POLLUTION PREVENTION ALTERNATIVES
Flow Diagram - Level I

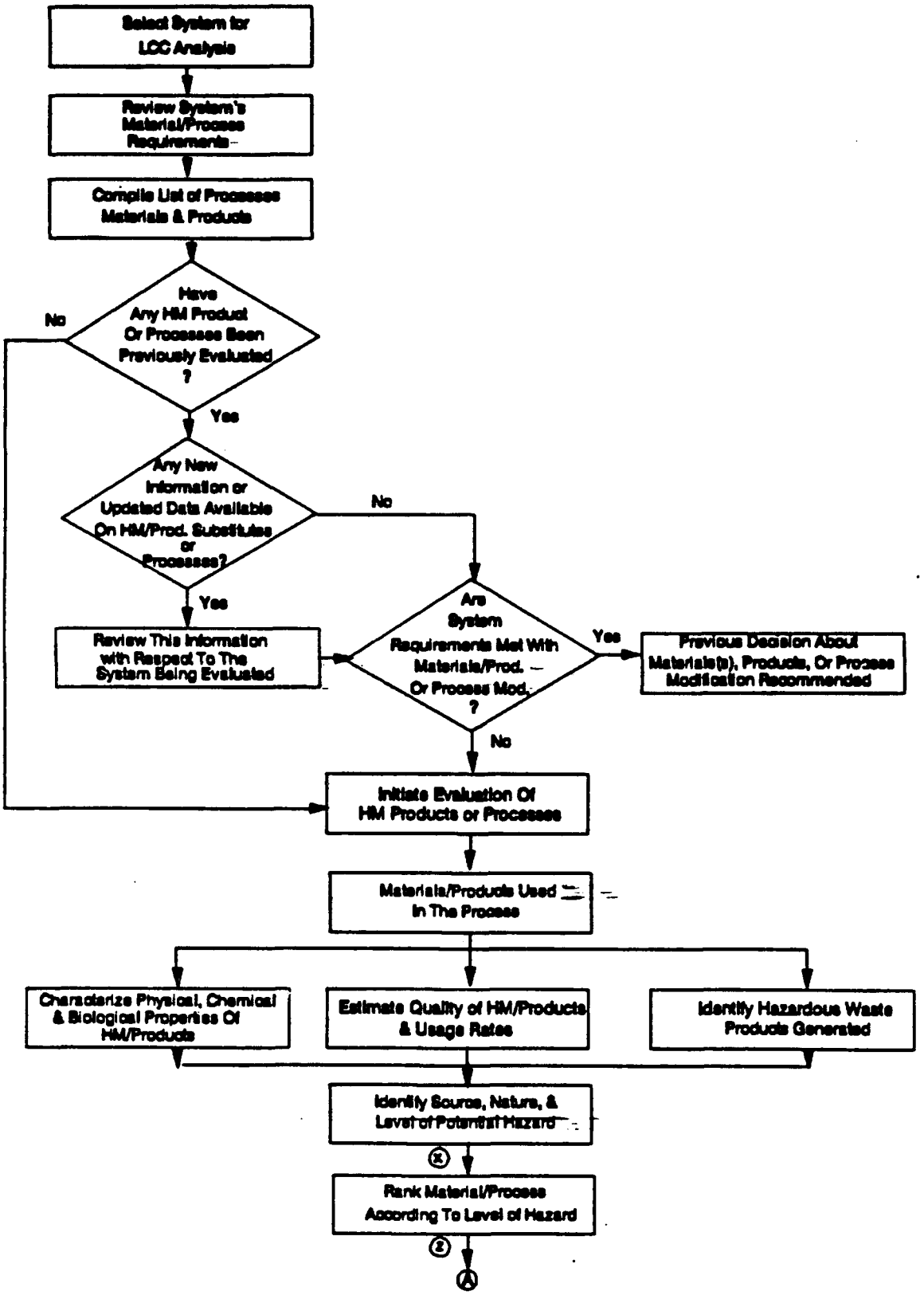


FIGURE 5 - 2

ECONOMIC ANALYSIS OF POLLUTION PREVENTION ALTERNATIVES

Flow Diagram - Level II

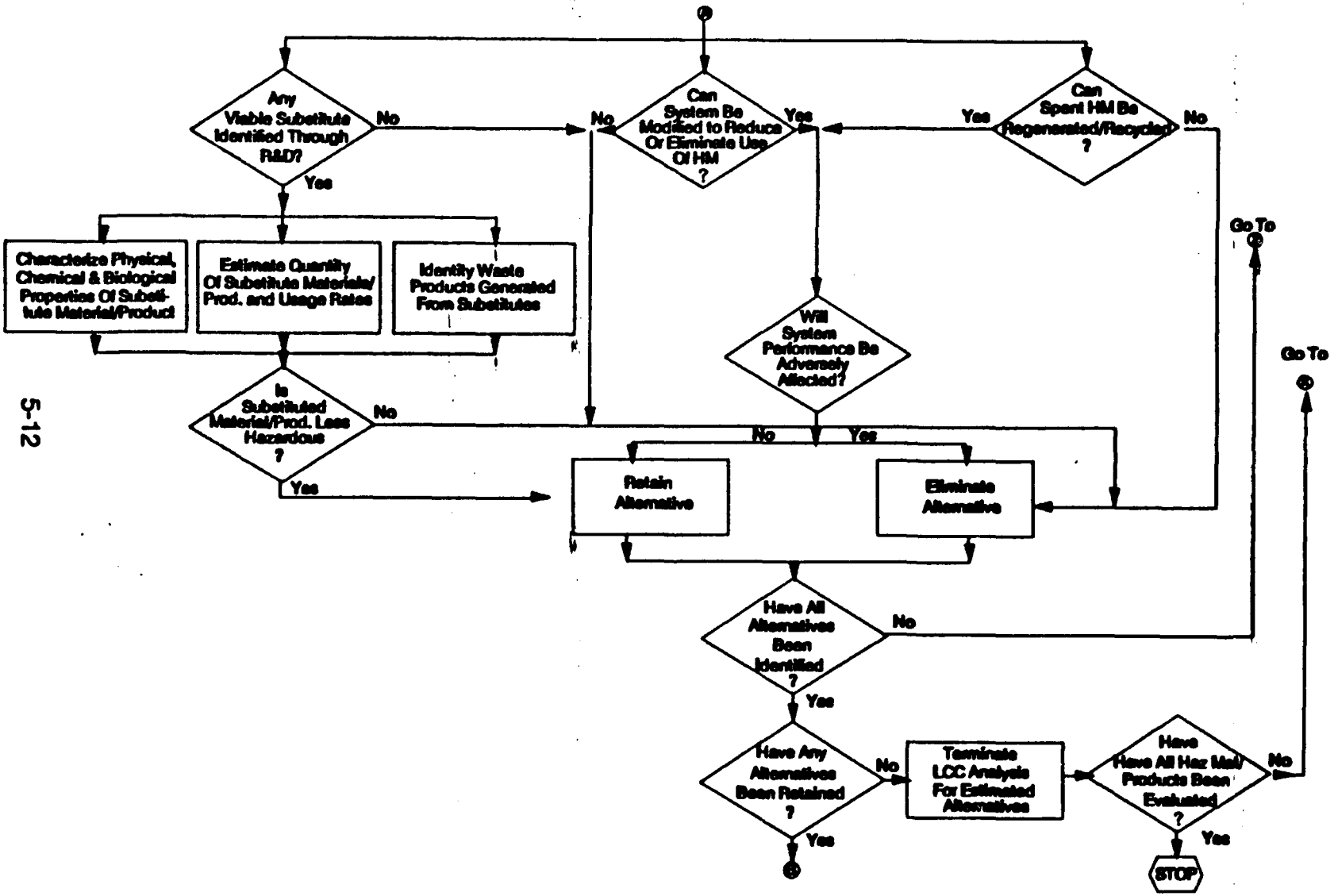
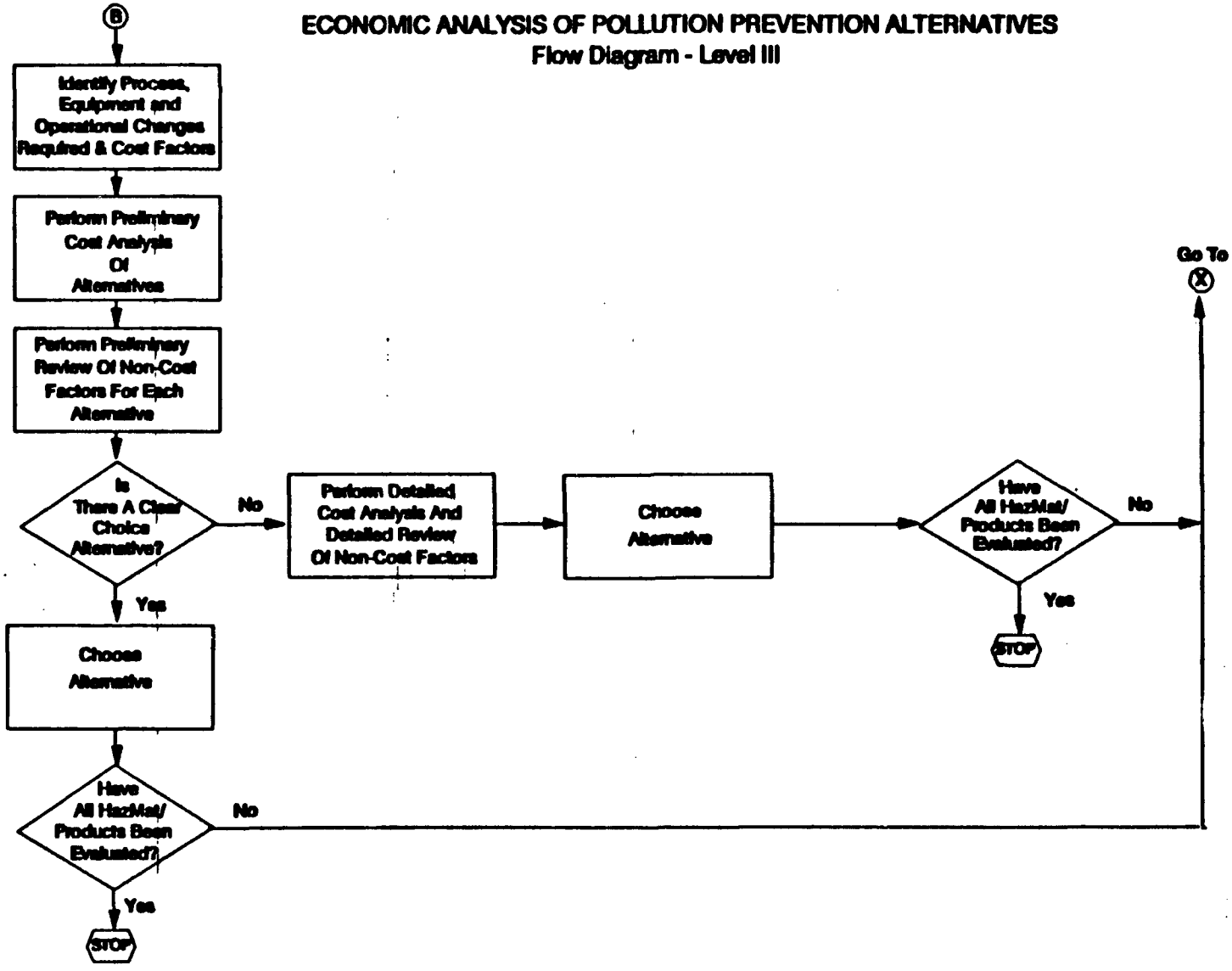


FIGURE 5 - 3

ECONOMIC ANALYSIS OF POLLUTION PREVENTION ALTERNATIVES

Flow Diagram - Level III



Review of System Requirements -- begins after the selection of a new or alternative system as a possible replacement of an existing system. The term "system," when used in this Manual, refers to an entire weapon system, a weapon sub-system, a particular industrial process or a specific HM associated with one or more related processes.

First, the system's material requirements are reviewed and all essential materials identified. A comprehensive list of materials is then compiled to include system-specified materials as well as associated process materials necessary to support the system throughout its life cycle. Also, materials classified as non-hazardous, but which may interact with other non-hazardous or HM to produce hazardous by-products under operating conditions, are identified. These non-hazardous/hazardous materials may require evaluation as a group and should be identified as such.

Identification of Previously Evaluated Materials--this step involves identifying previously evaluated HM (performed by DoD or Navy) for its potential human health and environmental effects. The current status of a material could be obtained from the Navy's materials database, other DoD databases, or from manufacturer's MSDSs, technical literature, or other published sources. If a pollution prevention alternative that uses HM has been previously identified, evaluated, and successfully tested without adversely affecting system performance, then it may be recommended for use. This step ensures unnecessary duplication of time and effort and avoidance of misuse of resources.

Characterization and Ranking of Hazardous Materials--the objective here is to identify those materials that pose the greatest human health and environmental hazards and are likely to generate a significant volume of HW. This process consists of the following steps:

- Characterizing the physical, biological and chemical properties of HM
- Estimating HM quantities and use rates
- Identifying and estimating the quantity of potential HWs to be generated
- Evaluating potential hazards of the materials
- Ranking the materials in order of significance.

The characterization step pertains to compiling the HM's physical, chemical and biological properties which are required to assess risks associated with its use. To accomplish this task, obtain information from the same sources cited above for previously evaluated materials. Information necessary to characterize the HM properties should be collected and displayed in standard formats. (See Worksheets presented later in this Chapter).

HM quantities/use rates and quantities of HW products likely to be generated should be estimated by the user based on available information and/or assumptions. The amount of HW generated depends on the nature and

quantity of materials involved, the processes employed, etc. No standard methods or procedures for obtaining realistic estimates of generated HWs are currently available. Thus, the user may have to rely on prior experience with the material under similar applications or assistance from an outside source.

The information obtained is then compiled and used to quantify the level of the potential hazard to human health and the environment. The source, nature, and level of potential hazard of each material or group of materials are determined. The HM are then ranked, including the level of hazard associated with their use, the quantity required, and the type and amount of HW produced. (The detailed procedure for performing this ranking is provided later in this Chapter). This ranking prioritizes the order in which the materials should be evaluated, based on the availability of resources, and allows for eliminating materials that rank very low. For example, if a material poses minimal or insignificant danger to human health and the environment, it could be eliminated from further consideration.

5.3.2 Level II - Identification of Pollution Prevention Alternatives

Level II is used to identify pollution prevention alternatives that minimize or eliminate the use of HM and corresponding HW production.

The process for identifying pollution prevention alternatives follows a hierarchy in which source reduction options are explored, followed by recycling options. This hierarchical approach is consistent with DoDD 4210.15 and stems from the environmental desirability and cost effectiveness of source reduction as the preferred means of minimizing waste. Source reduction techniques minimize or avoid HW generation, thereby reducing (or eliminating) the associated waste handling/disposal costs. Recycling techniques allow HM to be put to beneficial use. Treatment options should be considered after acceptable waste minimization techniques have been identified.

Pollution prevention alternatives include, but are not limited to, the following:

- Good operating practices
- System modification
- Material substitution
- Recycle/regeneration

Good operating practices are procedural, administrative or institutional measures that minimize waste at a cost savings or for a minimal incremental cost. Good operating practices include: waste minimization programs; management and personnel practices; materials handling and inventory practices; loss prevention which minimizes wastes by avoiding leaks from equipment and spills; and waste segregation which reduces HW volume by preventing the mixing of hazardous and non-hazardous wastes, etc.

System modification alternatives are oriented toward process and equipment changes to reduce or eliminate HM use and HW generation during production and other system life cycle phases. These modifications range from minor changes involving relatively low cost to major equipment or process changes involving large capital costs.

Material substitution alternatives can accomplish HW minimization by reducing or eliminating HM that enter key processes, and consequently, avoid or reduce HW generation. Data from the Navy's R&D program or other DoD R&D programs could be used to determine if a non-hazardous or less HM could be substituted. The alternative material identified is subjected to information gathering activity used to characterize the original proposed material, including characterizing the physical, chemical and biological properties of the material, the estimated quantity and use rate, as well as the quantity/type of HW generated.

The data collected are then used to determine the level of hazard associated with the new material and the amount of HW to be generated. The results are compared with the results for the current material. If the hazard level and HW generated are not significantly reduced by using the alternative material, then material substitution is not a feasible alternative. If HW generation is reduced significantly, then the analysis is continued. A check to ensure that the material has no adverse effects on system performance is included as the next part of the analysis.

Recycling alternatives involve the use and/or reuse of a waste material in the originating process as a substitute for an input material, or for another process as an input material. Recycling can also involve regeneration or recovery of a valuable material from a HW which could then be sold.

For each HM or group of HM, the appropriate pollution prevention alternatives should be evaluated in parallel to ensure that all pollution prevention alternatives have been considered. If no viable alternatives are identified, the LCC analysis for that HM is terminated. The analysis of the next ranked material (determined in Level I) is then started.

5.3.3 Level III - Life Cycle Cost Analysis and Alternatives Evaluation

The requirements for implementing the alternatives must be determined after all the Level II pollution prevention alternatives have been identified. (See Figure 5-3). The requirements may include process, equipment, operational and other changes for the alternatives. The cost factors related to these changes are the elements to be identified.

Because processes or systems are unique and have requirements and other factors that dictate cost, it may not be feasible to develop a comprehensive list of cost factors to address every possible situation that may be encountered. The list of cost factors shown previously in Table 5.2 was developed to assist the user community in identifying the appropriate cost factors. Generic in nature, this listing is not an exhaustive compilation of all pertinent factors that must be considered for any given system. The list can be expanded or condensed, as appropriate, to provide the level of detail desired by the user.

The preliminary LCC analysis utilizes an incremental cost analysis approach consistent with SECNAVINST 7000.14B. The incremental costs associated with a pollution prevention alternative are related to the costs associated with the use of proposed or already existing material(s).

Prior to initiating the analysis, the user should provide some basic information about competing alternatives, related processes, and the material to be evaluated.

For purposes of this "semi-quantitative" analysis, the estimated incremental costs are classified in five ranges (shown below), each assigned a cost unit that varies logarithmically. The cost units could be expressed in thousands or millions of dollars, depending on the size and complexity of the system being analyzed.

Incremental Cost Range	Cost Unit
Less than 1	0
Between 1 and 10	1
Between 10 and 100	10
Between 100 and 1000	100
Greater than 1000	1000

After identifying all the cost factors, the user determines the range of incremental costs associated with each factor and selects the appropriate unit. This procedure is repeated for all cost cycle phases for each alternative. The sum of the cost units for each alternative is calculated and summarized. The incremental costs and intangible factors should be evaluated to determine if one alternative is clearly superior. The superior alternative should be recommended for implementation. If two or more alternatives offer similar costs/savings and intangible benefits, then a detailed cost analysis and intangibles evaluation should be performed for those alternatives, prior to making a recommendation.

Preliminary LCC analysis results could also be used to identify cost drivers which may streamline future analyses. Major differences in cost between two alternatives may often be reduced to significant differences in only one or two overriding cost factors. In that case, an exhaustive evaluation of each cost factor's contribution in the detailed LCC analysis may be unnecessary.

Both the preliminary and detailed cost analyses require that the user choose the method of economic analysis and input factors. The preferred methods of analysis are Net Present Worth (NPW) or Equivalent Uniform Annual Cost (used if the alternatives have different economic lives). Other factors to be identified prior to economic analysis include the applicable life cycle phases, cost factors, analysis period, interest rate, inflation rate, etc.

The primary difference between the two economic analysis approaches, the preliminary and detailed, is how incremental costs are calculated and presented. The preliminary cost analysis uses the estimated incremental cost ranges and cost units presented earlier, while the detailed cost analysis does not. The user should develop values for the incremental costs. More specific cost estimating techniques and documentation will be required for the detailed analysis.

5.4 APPLYING THE HMC&M ECONOMIC ANALYSIS MODEL

System evaluation can begin at any one of the three levels depending on the scope of the problem and information available. For example, after completing the evaluation of HM substitutions, the

user may bypass Level I and commence with Level II analysis. In addition, if viable HMC&M alternatives have been identified, the user may move to the Level III analysis.

Sample Worksheets for recording and compiling data are provided at the end of this section. While not mandatory, use of these worksheets will allow the user to document the evaluation of alternatives. The steps of the proposed economic analysis approach are presented below.

5.4.1 Identify System/Scope of Economic Analysis

The entity to be evaluated could range from a new major weapon system, an existing weapon system, a subsystem, or an industrial process used in support of a system, or simply, a single HM. The scope and objectives of the analysis must be clearly stated at this stage. For example, if the analysis involves the substitution of only one material, then the analysis should begin at Step 14. Table 5.3 shows the purpose of each worksheet and the corresponding step in the process. This Table can be used to determine where the analysis should begin for each system.

The evaluation should be conducted on the materials associated with the system or process during its life cycle. If a system uses 100 materials, then the materials should be broken down into components (or groups of materials) and evaluated by each material. Materials deemed to be most significant (from step 8) in terms of hazardous components and waste products generated should be evaluated first.

Worksheet 1 should provide as much detail as possible about the system to be evaluated, including a description of all subsystems, components, etc., as well as the system's expected economic life.

5.4.2 Identify Applicable LCC Phases

Worksheet 2 provides a checklist to identify the LCC phases applicable to the economic analysis. In accordance with SECNAVINST 7000.14B, economic analysis/program evaluation studies should be initiated as early in the acquisition process as practical and be updated as significant developments occur.

Specify the LCC phases to be evaluated for the system, subsystem, process or material identified on Worksheet 1. For a new weapon system, the analysis may involve all six phases of the life cycle, from concept exploration and definition to final decommissioning. However, if a single process or HM are being evaluated, the economic analysis would be limited to the applicable LCC phases such as operations; maintenance and disposal. This approach will also eliminate life cycle phases that are not applicable to the system being evaluated or for which no information is available, thus preventing unnecessary efforts.

5.4.3 Review System Material Requirements and Compile List of Materials

This step involves examining system or process documentation to identify performance requirements and the materials and processes specified to meet these requirements. Adequate information and decisions about material use may not

TABLE 5.3 - WORKSHEET SUMMARY

Worksheet No.	Step	Purpose
1	2	Identification of system/process.
2	2	Identification of applicable life cycle phases.
3	3	Identification of the system/process material requirements.
4	4	Identification of any previously evaluated materials, products, or processes.
5	5	Identification of material/product characteristics and determination of hazardous material selection factor.
6	6	Identification of the source, nature, and level of potential hazard.
7	7	Identification of process ranking information.
8	8	Determination of process ranking.
9	10	Determination of substitute material/product characteristics and determination of hazardous material selection factor.
10	11	Determination of prioritization factors for material/product substitution alternatives.
11	12	Identification of system modification pollution prevention alternatives.
12	13	Identification of regeneration/recycling pollution prevention alternatives.
13	14	Identification of equipment/operational changes required for each pollution prevention alternative.
14.0 - 14.5	15	Determination of incremental costs for each alternative and the applicable life cycle phases and cost factors.
15	15	Summarizes the incremental cost subtotals for each life cycle phase.
16	16	Identification of intangible (non-cost) factors associated with each alternative.
17	17	Determination of the hazardous waste reduction potential of each alternative.
18	18	Summarizes information for each alternative including: incremental costs, non-cost factors, and hazardous waste reduction potential; allows direct comparison of alternatives.

have been established during the early life cycle phases. If materials have not been explicitly identified, more judgment will have to be used in identifying the materials. Where there is a choice of materials, the less hazardous or non-hazardous material should be selected to eliminate the need for evaluations or process changes. For evaluations conducted during the development, testing and subsequent life cycle phases, the user may obtain material requirements and the range of possible material options from design and development documents.

The user should develop a comprehensive materials list after reviewing system documentation. Materials associated with system support processes should be systematically identified using Worksheet 3. Materials should be classified as hazardous in accordance with the current criteria established by Federal Standard 313C or equivalent U.S. EPA criteria. (Materials and processes associated with raw materials should not be included in this evaluation).

5.4.4 Identify Previously Evaluated HM

With input from Worksheet 3, use Worksheet 4 to record HM previously evaluated for use in a similar process or system. Review any new or updated information on the material. Also, determine if the HM meets the system requirements. If no updated data are available for previously reviewed material and the material meets system requirements, do not evaluate further. Previous decisions about material use and associated processes may be recommended under these circumstances.

Review updated data from various sources including scientific literature, Code of Federal Regulations, industry working groups or Navy or other DoD research facilities. With respect to system requirements, determine whether a material re-evaluation is necessary. New data could include new regulations, new scientific data (e.g., additional environmental impact data) or new technical data (e.g., techniques, processes or material substitutions).

5.4.5 Identify Material/Product Characteristics

Worksheet 5 is used in gathering information about the identified materials/products for use throughout the prioritization and economic analysis processes. Information about each material/product, which should be gathered separately, can be found in a number of different sources, including MSDSs provided by manufacturers. Other information sources include EPA documents and hotlines, and documents listed below. If sufficient data are not available, it may not be possible to evaluate that material/product. Every effort should be made to determine the hazardous characteristics of a material/product and its subsequent waste products. The paragraphs below describe some possible resources for material information.

Information resources for material characteristics include OSHA Permissible Exposure Limits (PEL) found in MSDSs and the OSHA Health and Safety Standards (29 CFR 1910). Medical effects, including primary route of exposure, acute and chronic effects, and carcinogenic

information, can normally be found in MSDSs. Information sources on carcinogens include the National Toxicology Program (NTP) Annual Report of Carcinogens, International Agency for Research on Cancer (IARC) Monographs and the OSHA list of potential carcinogens. The NIOSH Registry of Toxic Effects of Chemicals lists the findings of NTP, IARC and OSHA.

The Reactivity Hazard Data and flashpoint of materials can usually be found on MSDSs. The National Fire Protection Agency (NFPA) produces a rating for health, flammability, and reactivity characteristics of materials. Similarly, The National Paint and Coatings Association (NPCA) has proposed a Hazardous Material Identification System (HMIS) that categorizes health, flammability, reactivity and personal protection data for materials. These two ratings can sometimes be found on MSDSs or can be requested from NFPA or NPCA.

EPA's list of priority pollutants and the Clean Air Act (CAA) Amendments should be reviewed for information related to environmental impact issues. State or local governments also provide information concerning requirements for environmental impact statements, environmental assessments, and air/water quality permits.

For existing materials, the mass of material used annually may be obtained from inventory data. For newly proposed materials, the mass may be estimated based on mass balance calculations. Data on reportable quantity for materials and wastes can be found in Table 302.4 of 40 CFR, Part 302.

Attachment 5A is used to gather information to prioritize the evaluation of the materials. The characteristics of both the material/product and waste should be taken into account. Worksheet 5 and Attachment 5A are used to determine the Hazardous Material Selection Factor (HMSF). The HMSF takes into account the material's characteristics in addition to the circumstances of its use. It should be noted that the higher the HMSF number the greater the environmental risk. If the HMSF has already been identified, then disregard Attachment 5A and fill in the HMSF on Worksheet 5.

5.4.6 Identify Source, Nature and Level of Potential Hazard

Worksheet 6 provides the step-by-step instructions for calculating the prioritization factor for each material and/or product. The values calculated, based on these instructions, are then used as input on subsequent worksheets.

The first prioritization factor (PF-1), introduced in Step 2 of Worksheet 6, is a measure of the hazard associated with a material's use, as well as with the mass of material used in one year. The HMSF determined on Worksheet 5 is used to calculate the PF-1. The second prioritization factor (PF-2), introduced in Step 3 of Worksheet 6, is based on the amount of waste to be generated, compared to the reportable quantity for that waste.

5.4.7 Identification of Process Ranking Information

The purpose of Worksheet 7 is to summarize information used for process

ranking. The HMSF calculated in Worksheet 5 for each material/product is summarized on Worksheet 7, in addition to the following information: mass of hazardous material/product used (HMM); mass of hazardous waste generated (HWM); and final reportable quantity (FRQ) of the hazardous waste. The HMM, HWM, and FRQ are described on Worksheet 6. The information summarized in Worksheet 7 is subsequently used to calculate the prioritization factors described on Worksheet 6.

5.4.8 Determination of Process Ranking

Worksheet 8 is provided to summarize the prioritization factors calculated according to the instructions in Worksheet 6. The information summarized in Worksheet 7 is used for these calculations. The purpose of these calculations is to prioritize the materials or products for subsequent steps of the economic analysis approach.

PF-1 and PF-2 factors are used to calculate the average rank (PFAR) for each material/product, as described in Worksheet 6. The order of evaluation for the materials/products corresponds to the material/product PFAR (i.e., lowest PFAR is evaluated first, etc.). The evaluation process should be performed on the basis of the individual materials/products and the pollution prevention alternatives identified later in Step 9 for the material being evaluated. For each material/product or process, the evaluation should be performed through Step 18. Refer back to Worksheet 8 and select the material, product, or process with the next lowest PFAR. Repeat the evaluation process until all materials/products or processes identified in Steps 3 and 5 have been evaluated.

The number of materials evaluated are determined by the resources available. According to SECNAVINST 7000.14B, an economic analysis is not required when the minimum level required to do the analysis would not be worth the benefits gained by such an analysis. By ranking materials according to their hazard level, the maximum benefit should be gained by evaluating the high hazard materials, products or processes first.

5.4.9 Identification of Pollution Prevention Alternatives

No worksheet is provided for this step. However, pollution prevention alternatives for each material, product, or process may be identified by using the procedures described below. These procedures have been adopted from the "Waste Minimization Opportunity Assessment Manual" (EPA, 1988).

Select an Assessment Team--a group of system/process/material experts should be utilized as a primary resource in identifying potential pollution prevention alternatives. If such a group has not already been established, steps should be taken to establish and select an assessment team comprising process engineers, environmental engineers and scientists, managers, Research and Development (R&D) personnel and economists to identify potential pollution prevention alternatives.

Generate Pollution Prevention Alternatives--the assessment team's proposed alternatives should offer significant reduction in HW generation without adverse effects on system performance. The alternatives identified should be summarized on Worksheets 9 through 11. Additional information for pollution prevention techniques is available from trade associations, plant engineers and operators, published literature, state and local environmental agencies, equipment vendors, and consultants.

5.4.10 Identification of Substitute Material/Product Characteristics

Assuming that the substitute material has been tested and does not adversely affect system performance, Worksheet 9 is used to identify alternative materials (either less hazardous or non-hazardous) that can substitute directly for the HM being evaluated. The Worksheet facilitates information gathering necessary to evaluate the substitute material, based on hazard level and type of HW generated.

If any information required on Worksheet 9 is not applicable to the substitute materials (i.e., it is not hazardous) then fill in the space with N/A (not applicable) or none. Determine if the substitute material is less or more hazardous then the material being evaluated. This information and results may also be used in the final decision making process of the LCC analysis (see Worksheet 18).

5.4.11 Determination of Prioritization Factors For Material/Product Substitution Alternatives

Use copies of Worksheets 7 and 8 and the instructions provided in Worksheet 6 to determine PF-1 and PF-2 factors for the substituted material(s). Worksheet 6 need only be completed through Step 3. Worksheet 10 is provided to summarize and compare PF factors for the existing materials or products and the proposed substitution materials or products. If the PF-1 or PF-2 factor of the substituted material/product is greater than those of the existing material/product, then the substituted material/product should not be retained as an alternative subjected to economic analysis.

5.4.12 System Modification Alternatives

Worksheet 11 is used to list and describe (briefly) any proposed system modification alternatives identified through Step 9.

5.4.13 Regeneration/Recycling Alternatives

Worksheet 12 is used to list and describe any regeneration/recycling alternatives identified through Step 9.

5.4.14 Identify Equipment and Operational Changes and Affected Cost Factors for Each Alternative

Equipment and Operational changes--after identifying, describing, and summarizing each pollution prevention alternative on Worksheets 9 through 12, identify changes to equipment, procedures, etc., required by each of these alternatives. Changes will have a positive, negative, or no effect on each cost factor (described below in Step 14.b) when compared to the base condition. Worksheet 13 should be completed for each alternative with requirements that are more or less than those for the base condition (i.e., use of HM). For example, implementing a recycling alternative may require a capital investment in equipment, but may reduce HW handling and disposal costs.

Identification of Cost Factors--a system or process that uses HM involves a number of factors that influence system or process costs during its life cycle. This section provides a brief description of factors to be considered when identifying incremental costs applicable to a given alternative. (Note: this is not an exhaustive listing or description of cost factors; it is provided to assist users in identifying factors applicable to the system under evaluation.)

Cost factors are of two types: tangible costs and intangible costs. Tangible costs are defined as costs which are quantifiable, while intangible costs are those that are not readily quantified. Only tangible costs are considered in the preliminary LCC analysis.

Tangible costs can be divided into nonrecurring (investment) and recurring (operations) costs per SECNAVINST 7000.14B. Nonrecurring costs are those associated with the acquisition of equipment, real property, nonrecurring services, nonrecurring operation and maintenance (start-up) costs and other one-time investment costs. Any residual costs (i.e., salvage value) associated with an alternative should be considered as a reduction in cost for that alternative. Recurring costs include personnel, materials consumed in use, operating, overhead, and the cost of support services required on an annual basis.

The following cost factors involve elements of both recurring and nonrecurring costs which should be taken into account when determining the incremental costs:

- **Management Costs** - This factor involves personnel costs for managing the HM control and management program during a weapon system's life cycle phases to accomplish overall program objectives. Examples of management activities are contract management, configuration management, data management, liaison, value engineering, quality assurance, quality control, and logistic support management.

- **Procurement Costs** - The cost to purchase HM for use in producing, deploying, operating and supporting the various Navy systems are procurement costs. These costs affect the Navy and prime contractors.

- **Engineering/Design Costs** - These costs refer to engineering efforts associated with system, process or equipment design and development and includes the cost of: systems engineering and integration; design engineering (structural, electrical, mechanical, construction, etc.); design support (reliability, maintainability, human factor engineering and safety, value engineering, etc.); and redesign or engineering changes due to HM use or implementation of pollution prevention alternatives. Direct labor costs, materials, and other direct costs incurred during the engineering process are included. Costs for developing computer software and using computer time should be included.

- **Training Costs** - This factor represents initial and yearly personnel training costs for handling HM and operating and maintaining related equipment. Costs include satisfying OSHA or equivalent requirements for hazardous communication and training for HM site workers; spill response; and emergency First Aid. Costs associated with special training facilities, training devices and equipment, and periodic refresher courses for operator, maintenance and instructor training are part of this factor.

- **Handling Costs** - These costs deal with handling HM including supply (distribution), storage, inventory, control and labeling. The handling cost factor is mainly personnel costs, including lost productivity of personnel due to controls and restrictions required for HM use.

- **Transportation** - This cost deals with transporting materials from the arrival or storage point to the place used and encompasses the equipment and personnel necessary for transportation. This factor does not include shipping costs from the manufacturer--these are procurement costs. HW transportation to its ultimate disposal location is part of the disposal/recycle cost factor.

- **Support Equipment and Personnel Costs** - HM use and operation of related equipment include such cost items as electrical power expense, consumables (e.g., petroleum, oil and lubricants, paper, etc.), and manpower costs (including personnel pay, allowances, support costs, incentives, and replacement training costs). Purchasing, using, and maintaining equipment needed to handle HM/HW are part of the support equipment costs. Laboratory equipment, storage cabinets, special containers, handling equipment, spill response equipment and showers/eyewashes are items associated with such costs.

- **Disposal/Recycle Costs** - This cost factor involves disposing of or recycling HW. HW includes HM whose shelf-life has expired, and soils, sludge, sediments and groundwater contaminated by HM or wastes. Disposal costs consist of

wastewater treatment, HW characterization, and costs for ultimate off-site disposal. Costs for recycle equipment, spare parts, accessories and supplies are included. If the cost of recycling equipment is already in the procurement cost, do not add it here.

- **Personal Protective Equipment (PPE) Costs** - Providing PPE for handling or working in the vicinity of HM or HW wastes is part of this cost factor. The cost to procure, maintain and distribute the equipment (respirators, gloves, body suits etc.) are also integral to it. Because PPE may restrict or reduce user efficiency, the estimated cost of lost productivity must be incorporated.

- **Medical Costs** - The costs associated with physical examinations, medical surveillance, lost time from work due to illness/injury, physical examination and industrial hygiene surveys should be included. Surveillance cost involves personnel costs for carrying out the medical program (including record keeping and maintaining compliance with OSHA or other regulatory authority).

- **Legal and Environmental Costs** - These costs involve lawsuits and property damage resulting from HM use and HW generation/disposal as well as remediation costs for soil and groundwater contamination. Among the costs are correspondence with regulatory authorities and legal actions necessary to bring Navy facilities into compliance with current and future HW regulations. RCRA TSDF requirements, including inspections, contingency plans, manifest system, recordkeeping, and reporting, and facility closure and post closure requirements, are part of the environmental costs.

- **Support Facilities Costs** - The cost of designing, constructing and maintaining facilities where HM/HW are stored or used are part of this factor. Engineering controls required in existing facilities should also be included.

- **Other** - Each factor contains a separate category, "other," to allow for adding sub-factors which may not be included on Worksheets 14.0 through 14.5. This approach allows for greater flexibility in completing the LCC analysis.

5.4.15 Perform Preliminary Analysis of Each Alternative

Worksheets 14.0 through 14.5, which address each life cycle phase, include tables for determining the incremental (uniform annual) LCC for each alternative identified on Worksheet 12. The worksheets which correspond to the appropriate life cycle phases for the alternatives being evaluated should be completed. Worksheet 13 provided information for determining the base cost (all costs associated with HM use) and the incremental costs for each alternative. (The uniform annual base cost should be an order of magnitude cost estimate and

completed only if known or needed to determine an incremental cost for an alternative). The following procedures may be followed:

1) Determine the incremental costs (those added to or deducted from the base condition) for each alternative over its economic life (the period during which an alternative is executed in order to accomplish the system objectives). For example, if the alternative requires a cost beyond what is required for the base condition, the incremental cost would be positive. If the alternative results in a cost reduction, the incremental cost would be negative. Economic analysis conventions assume that all periodic costs occur at the end of the year in which they were incurred, while initial capital costs occur at the beginning of economic life. The same base time should be used for each alternative. Each alternative should begin at a common point in time, i.e., the first point at which costs for any alternatives are incurred.

2) All incremental costs should be expressed as equivalent present incremental costs to adjust for the change in the value of money over time. This adjustment is accomplished by using a discount rate (expressed as a percent or fraction per year). When the discount rate is applied to single amount F, occurring N years in the future, the present value P is:

(Equation 1)

$$P = F\left(\frac{1}{(1+i)^N}\right) = F\,(P/F,i,N)$$

where i = discount rate, fraction per year (i.e., 10% per year is 0.10 per year), and (P/F,i,N) is a convenient representation of the term in ( ). This is known as the single payment present worth factor.

When a uniform cost A occurs over N years, the equivalent present value is:

(Equation 2)

$$P = A\,\frac{(1+i)^N - 1}{i\,(1+i)^N} = A\,(P/A,i,N)$$

where (P/A,i,N) is a convenient representation of the term in ( ). This is known as the uniform series present worth factor.

3) Divide each alternative's present value by the uniform series present worth factor associated with its economic life. This gives each alternative's uniform annual incremental cost. The alternative with the lowest annual incremental cost is the most cost-efficient alternative.

The base cost column refers to material being evaluated. The annual base cost could be zero if the material's use does not incur a cost for a particular cost item. Incremental costs for each alternative can be positive or negative. Assign an incremental cost unit (CU) for each alternative corresponding to the incremental cost ranges provided below for each cost item:

Incremental Cost Range($)	CU
Less than 1	0
Between 1 and 10	1
Between 10 and 100	10
Between 100 and 1000	100

(Continue to increase by 1 order of magnitude as necessary).

Total the incremental costs by adding each column and placing these subtotals at the bottom of each worksheet (taking into account positive and negative cost units).

Worksheet 15 summarizes the incremental cost subtotals (by phase) calculated on Worksheets 14.0 - 14.5 . Summing the column provides the total incremental cost over the alternative's life. A positive incremental cost indicates that the alternative would cost more to implement, while a negative incremental cost indicates that the alternative would cost less to implement, than using existing materials.

5.4.16 Identify Intangible Factors Related to Each Alternative

Use Worksheet 16 to list intangible factors (those without specific dollar values) that might influence the implementation of retained alternatives. Intangible factors may have a positive or negative impact and override an otherwise cost-effective alternative.

5.4.17 Determine the Hazardous Waste Reduction Potential of Each Alternative

Use Worksheet 17 to determine each alternative's HW reduction potential. The HW mass to be generated for the base material(s) was identified on Worksheet 6. The percentage reduction should be based on any anticipated decrease from this base level.

5.4.18 Identify the Best-Choice Alternative

Worksheet 18 summarizes the information gathered during the LCC analysis and other aspects of the evaluation which can be used to compare alternatives for a HM process or system. This information represents, in effect, costs and benefits of the proposed alternatives. The information used in the comparison includes total incremental costs (Worksheet 15), intangible factors (Worksheet 16), and HW reduction potential (Worksheet 17).

Decisions regarding the acceptability of various alternatives can be made using Worksheet 18 data. If a clear choice alternative exists (based on all factors), then it may be chosen. The next ranked material (from Worksheet 8) should be evaluated if no alternatives are acceptable. If two or more alternatives have approximately the same benefits/costs, then a more detailed cost evaluation should be performed on those alternatives. The next ranked material (Worksheet 8) should be evaluated after evaluating a particular material or group of materials. This process should continue until all materials are evaluated in the process or system being analyzed.

WORKSHEETS FOR ECONOMIC ANALYSES IN HAZARDOUS MATERIAL CONTROL AND MANAGEMENT DECISIONS

WORKSHEET 1
SYSTEM/PROCESS IDENTIFICATION

PROJECT LOCATION:

CHOOSE ONE OF THE FOLLOWING (CHECK):
1. EVALUATING WEAPON SYSTEMS? _____
2. EVALUATING PROCESSES? _____
3. EVALUATING DIRECT MATERIAL SUBSTITUTION? _____

DESCRIBE THE WEAPON SYSTEMS, PROCESSES OR MATERIALS TO BE EVALUATED BELOW:

IDENTIFY SYSTEMS, PROCESSES OR MATERIALS	DESCRIPTION
1	
2	
3	

USE ADDITIONAL SHEETS IF NECESSARY

WORKSHEET 2

IDENTIFICATION OF APPLICABLE LIFE CYCLE PHASES

PROJECT LOCATION:

_____

IN THE TABLE BELOW FILL IN EACH SYSTEM, PROCESS OR MATERIAL IDENTIFIED ON WORKSHEET 1 AND CHECK THE APPLICABLE LIFE CYCLE PHASES.

LIFE CYCLE PHASE NUMBER	TITLE	IDENTIFY EACH SYSTEM, PROCESS OR MATERIAL AND THE APPLICABLE LIFE CYCLE PHASES BELOW				
0	Concept Exploration and Definition					
1	Demonstration and Validation					
2	Engineering and Manufacturing Development					
3	Production and Deployment					
4	Operations and Support					
5	Decommissioning					

USE ADDITIONAL SHEETS IF NECESSARY

WORKSHEET 3
SYSTEM/PROCESS MATERIAL REQUIREMENTS

PROJECT LOCATION:

IN THE TABLE BELOW IDENTIFY EACH PROCESS OR PROCESS COMPONENT, THE PRODUCTS USED IN THE PROCESS, THE HAZARDOUS AND NON-HAZARDOUS MATERIALS USED IN THE PRODUCTS, AND ANY HAZARDOUS WASTES PRODUCED BY THE PROCESS. IF A SYSTEM IS BEING EVALUATED IDENTIFY EACH PROCESS THAT WILL BE REQUIRED TO SUPPORT THE SYSTEM THROUGHOUT ITS LIFE. ONLY COMPLETE THE APPLICABLE PORTIONS OF THE TABLE FOR YOUR EVALUATION.

PROCESS OR COMPONENT	PRODUCT NAME	MATERIALS		HAZARDOUS WASTES
		HAZARDOUS	NON-HAZARDOUS	

USE ADDITIONAL SHEETS IF NECESSARY

WORKSHEET 4
IDENTIFICATION OF HAZARDOUS MATERIALS TO BE EVALUATED

IN THE TABLE BELOW IDENTIFY FOR EACH SYSTEM AND/OR PROCESS THE HAZARDOUS MATERIALS OR PRODUCTS USED AND INDICATE WHETHER THE MATERIAL HAS BEEN PREVIOUSLY EVALUATED, UPDATED INFORMATION EXISTS AND IF IT SHOULD BE EVALUATED.

SYSTEM	PROCESS	PRODUCTS/MATERIALS	PREVIOUSLY EVALUATED?		UPDATE ON MATERIAL INFO?		EVALUATE MATERIAL?	
			YES	NO	YES	NO	YES	NO

USE ADDITIONAL SHEETS IF NECESSARY

WORKSHEET 5
IDENTIFICATION OF MATERIAL/PRODUCT CHARACTERISTICS AND DETERMINATION OF HAZARDOUS MATERIAL SELECTION FACTOR

PROJECT LOCATION: _____

SEE ATTACHMENT A FOR INFORMATION REQUIRED TO COMPLETE WORKSHEET 5

		MAT/PROD		MAT/PROD		MAT/PROD	
CHARACTERISTIC	UNIT	# OR CODE	PTS.	# OR CODE	PTS.	# OR CODE	PTS.
1. PEL	ppm mg/cm						
2. MEDICAL EFFECTS							
3. MISHAP PROB.	hr/wk						
4. # OF PERSONS	#						
5. FLASHPOINT	F/C						
6. BOILING POINT	F/C						
7. PPE							
8. VAPOR PRESSURE	mm Hg						
9A. NEW HAZARD POT.							
9B. EPA/STATE B.A.L.							
9C. EIS							
9D. FED/STATE PERMITS							
9E. MILCON PROJECT							
9F. EA							
10. RQ CATEGORY							
11. CAA PERM. EMISS.	ton/yr						
HMSF (TOTAL PTS. COL)							

		MAT/PROD		MAT/PROD		MAT/PROD	
CHARACTERISTIC	UNIT	# OR CODE	PTS.	# OR CODE	PTS.	# OR CODE	PTS.
1. PEL	ppm mg/cm						
2. MEDICAL EFFECTS							
3. MISHAP PROB.	hr/wk						
4. # OF PERSONS	#						
5. FLASHPOINT	F/C						
6. BOILING POINT	F/C						
7. PPE							
8. VAPOR PRESSURE	mm Hg						
9A. NEW HAZARD POT.							
9B. EPA/STATE B.A.L.							
9C. EIS							
9D. FED/STATE PERMITS							
9E. MILCON PROJECT							
9F. EA							
10. RQ CATEGORY							
11. CAA PERM. EMISS.	ton/yr						
HMSF (TOTAL PTS. COL)							

USE ADDITIONAL SHEETS IF NECESSARY

ATTACHMENT 5A - INFORMATION REQUIRED TO DETERMINE THE HAZARDOUS MATERIAL SELECTION FACTOR.

1. Permissible Exposure Limit

ppm/mg/m^3	Points
0 - 100/0 - 0.5	8
101 - 175/0.51 - 2.0	7
176 - 250/2.01 - 3.5	6
251 - 335/3.51 - 5.0	5
336 - 417/5.01 - 7.0	4
418 - 500/7.01 - 8.0	3
501 - 1,000/8.01 - 10.0	2
>1,000/>10	1

2. Medical Effects

	Condition	Points
a.	No medical effect, such as nuisance noise or odor	0
b.	Temporary reversible illness requiring supportive treatment, such as eye irritation or sore throat	2
c.	Temporary reversible illness with a variable but limited period of disability, such as metal fume fever	4
d.	Permanent, non-severe illness or loss of capacity, such as eye damage	6
e.	Permanent, severe, disabling, irreversible illness or death, such as cancer	8

3. Length of Exposure

Type of Exposure	Points Based on Length of Exposure ≥ (hr/wk)		
	1-8	>8	Continuous
Irregular, intermittent	2	5	NA
Regular, periodic	3	6	8

4. Number of Persons Potentially Exposed

Persons	Points
1-2	1
3-5	2
6-7	3
8-9	4
10-22	5
23-35	6
36-49	7
>49	8

5. Flammable/Combustible Liquids Evaluation

A. Flammable Liquids (°F)

Flash Point (FP)	Boiling Point (BP)	Points
<73	<100	10
<73	≥100	9
73≤FP<100		8

B. Combustible Liquids (°F)

100 ≤FP <140	6
140 ≥FP <200	4
FP ≥200	2

6. Personal Protective Equipment (PPE) Requirements

PPE Requirements	Points
1. Either faceshield, gloves, apron, or bootees (one point skin protection)	1
2. One or more combination of faceshield, gloves, apron, or bootees (multiple point skin protection)	2
3. Goggles (eye protection)	3
4. Combination of goggles and gloves, apron, or bootees (eye and skin protection)	4
5. Cartridge/canister respirator one-half facepiece for gas, vapor, and/or particulate contamination (respiratory protection)	5
6. Cartridge/canister respirator full facepiece for gas, vapor, and/or particulate contamination (respiratory and eye protection)	6
7. Combination of cartridge/canister respirator full facepiece for gas, vapor, and/or particulate contamination and gloves, apron, and/or bootees (respiratory, eye, and skin protection)	7

ATTACHMENT 5A - INFORMATION REQUIRED TO DETERMINE THE HAZARDOUS MATERIAL SELECTION FACTOR.

PPE Requirements ..... Points

8. Supplied air respirator or self-contained breathing apparatus (respiratory and eye protection) 8

9. Combination of supplied air respirator or self-contained breathing apparatus and gloves, apron, and/or bootees (respiratory, eye, and skin protection) 9

10. Supplied air respirator or self-contained breathing apparatus and full impervious suit (complete protection) 10

7. Volatile Organic Compound (VOC) Evaluation

Vapor Pressure (mm Hg @ 70°F)	Points
201 and Higher	15
101 to 200	12
91 to 100	10
81 to 90	9
71 to 80	8
61 to 70	7
51 to 60	6
41 to 50	5
31 to 40	4
21 to 30	3
11 to 20	2
1 to 10	1
Below 1	0

8. Environmental Impact Evaluation

(Note: Consider each attribute a separate item of evaluation. A total of 34 points can be attained from A through F.)

Environmental Attributes ..... Points

A. New Hazard Potential -- Material results in a changed hazard potential (fire hazard, change in media [e.g., air pollutant to solid waste, etc.]). Assess points against candidate material exhibiting worst hazard 10

Environmental Attributes ..... Points

B. EPA/State Bad Actor Lists -- Material is on EPA Priority Pollutant List, Air Toxics List, EPA or State list of volatile organic compounds (VOC), ozone depleters, etc. 8

C. Environmental Impact Statement (EIS) -- Projected use requires EIS 6

D. Federal/State Permits -- Projected use involves air or water quality permit, or State Implementation Plan requirements, etc. 4

E. MILCON Project -- Projected use requires hazard control facilities and equipment, with military construction (MILCON) in excess of $200,000 4

F. Environmental Assessment (EA) -- Projected use requires an EA 2

9. Determine Reportable Quantities (RQ) Code and Points (see EPA's List of Hazardous Substances and Reportable Quantities - 40 CFR 302.4)

Table 302.4 Final RQ Category	Points
X (1# or less)	10
A (1# to 10#)	8
B (10# to 100#)	6
C (100# to 1,000#)	4
D (1,000# to 5,000#)	2
Not on list	0

10. Determine Clean Air Act (CAA) Permissible Emission (40 CFR 52.21(b) [23])

Allowable Tons Per Year	Points
7 or less	10
8 - 25	8
26 - 40	6
41 - 100	4
>100	2
Not on list	0

WORKSHEET 6

IDENTIFY SOURCE, NATURE, AND LEVEL OF POTENTIAL HAZARDS

The calculated values determined from Steps 1-5 should be put in the summary table provided in Worksheet 7.

(1) Determine the Hazardous Material Selection Factor (HMSF)

(See Worksheet 5)

(2) Determine the first Prioritization Factor (PF-1) for the hazardous material as follows:

$$PF\text{-}1 = HMSF \times HMM$$

Where:

PF-1 = Prioritization Factor One
HMSF = Hazardous Material Selection Factor
HMM = Mass of Hazardous Material Used/Year (kg)

For the case of multiple hazardous materials (e.g., used together in a process or system), then:

$$PF\text{-}1 = HMSF_1 \times HMM_1 + HMSF_2 \times HMM_2 + \ldots. HMSF_n \times HMM_n$$

(3) Determine the second Prioritization Factor (PF-2) for the hazardous waste produced by use of the hazardous material(s) as follows:

$$PF\text{-}2 = HWM_1/FRQ_1 + HWM_2/FRQ_2 + \ldots. HWM_n/FRQ_n$$

Where:

PF-2 = Prioritization Factor Two
HWM_n = Mass (kg) of the n^{th} Hazardous Waste Generated
FRQ_n = Final Reportable Quantity of the n^{th} Hazardous Waste as defined in Table 302.4 of 40 CFR Part 302

WORKSHEET 6
(CONTINUED)

IDENTIFY SOURCE, NATURE, AND LEVEL OF POTENTIAL HAZARDS

---

(4) **Rank each material or group of materials by PF factor in descending order (highest PF is number 1) for PF-1 and PF-2 and calculate the average rank (PFAR) as shown on the following table (use table in Worksheet 8 to summarize information):**

Material	PF-1	PF-2	PFAR
a	R_{a1}	R_{a2}	$(R_{a1} + R_{a2})\ 0.5$
b	R_{b1}	R_{b2}	$(R_{b1} + R_{b2})\ 0.5$
.	.	.	.
n	R_{n1}	R_{n2}	$(R_{n1} + R_{n2})\ 0.5$

Where:

a,b,..n = Hazardous material or group of materials
R_{a1} = Numerical rank of material a on the basis of PF-1
R_{a2} = Numerical rank of material a on the basis of PF-2
PFAR = Average rank of each material

(5) **Evaluate each material in order of their PFAR number as follows (the lowest PFAR is evaluated first):**

$$(1) \quad (2) \quad (n)$$
$$PFAR_1 < PFAR_2 .... < PFAR_n$$

WORKSHEET 7
IDENTIFICATION OF PROCESS
RANKING INFORMATION

	HMSF	HMM (Kg)	HWM (Kg)	FRQ (Kg)
PROCESS: - MATERIALS/PRODUCTS (LIST BELOW)				
PROCESS: MATERIALS/PRODUCTS (LIST BELOW)				
PROCESS: MATERIALS/PRODUCTS (LIST BELOW)				
PROCESS: MATERIALS/PRODUCTS (LIST BELOW)				
PROCESS: MATERIALS/PRODUCTS (LIST BELOW)				
PROCESS: MATERIALS/PRODUCTS (LIST BELOW)				

WORKSHEET 8
DETERMINATION OF PROCESS RANKING

PROJECT LOCATION:

IDENTIFY EACH PROCESS BELOW	PF-1	PF-2	PF-1 RANK	PF-2 RANK	PFAR
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					
PROCESS:					

USE ADDITIONAL SHEETS IF NECESSARY

WORKSHEET 9

IDENTIFICATION OF SUBSTITUTE MATERIAL/PRODUCT CHARACTERISTICS AND DETERMINATION OF HAZARDOUS MATERIAL SELECTION FACTOR

PROJECT LOCATION: _____

SEE ATTACHMENT A FOR INFORMATION REQUIRED TO COMPLETE WORKSHEET 5

		MAT/PROD		MAT/PROD		MAT/PROD	
CHARACTERISTIC	UNIT	# OR CODE	PTS.	# OR CODE	PTS.	# OR CODE	PTS.
1. PEL	ppm mg/cm						
2. MEDICAL EFFECTS							
3. MISHAP PROB.	hr/wk						
4. # OF PERSONS	#						
5. FLASHPOINT	F/C						
6. BOILING POINT	F/C						
7. PPE							
8. VAPOR PRESSURE	mm Hg						
9A. NEW HAZARD POT.							
9B. EPA/STATE B.A.L.							
9C. EIS							
9D. FED/STATE PERMITS							
9E. MILCON PROJECT							
9F. EA							
10. RQ CATEGORY							
11. CAA PERM. EMISS.	ton/yr						
HMSF (TOTAL PTS. COL)							

		MAT/PROD		MAT/PROD		MAT/PROD	
CHARACTERISTIC	UNIT	# OR CODE	PTS.	# OR CODE	PTS.	# OR CODE	PTS.
1. PEL	ppm mg/cm						
2. MEDICAL EFFECTS							
3. MISHAP PROB.	hr/wk						
4. # OF PERSONS	#						
5. FLASHPOINT	F/C						
6. BOILING POINT	F/C						
7. PPE							
8. VAPOR PRESSURE	mm Hg						
9A. NEW HAZARD POT.							
9B. EPA/STATE B.A.L.							
9C. EIS							
9D. FED/STATE PERMITS							
9E. MILCON PROJECT							
9F. EA							
10. RQ CATEGORY							
11. CAA PERM. EMISS.	ton/yr						
HMSF (TOTAL PTS. COL)							

USE ADDITIONAL SHEETS IF NECESSARY

WORKSHEET 10
DETERMINATION OF PRIORITIZATION FACTORS FOR MATERIAL SUBSTITUTION ALTERNATIVES

RECORD THE PF-1 AND PF-2 FACTORS FOR THE MATERIAL(S) USED IN THE PROCESS LISTED ON WORKSHEET 8. DETERMINE PF-1 AND PF-2 THE SUBSTITUTE MATERIAL(S) TO BE USED IN THE PROCESS. DIFFERENT COMBINATIONS OF SUBSTITUTE MATERIALS MAY BE EVALUATED IN THIS TABLE.

PROJECT LOCATION:

IDENTIFY EACH PROCESS AND SUBSTITUTE MATS. BELOW	PF-1	PF-2	RETAIN (Y/N)
EXISTING PROCESS MATERIALS			
			N/A
SUBSTITUTE PROCESS MATERIALS			

Substitute materials should be retained if both their PF-1 and PF-2 factors are less than the existing materials.

WORKSHEET 11
SYSTEM/PROCESS MODIFICATION ALTERNATIVES

PROJECT LOCATION: _____

IN THE TABLE BELOW IDENTIFY ANY SYSTEM/PROCESS MODIFICATIONS (INCLUDING PERSONNEL, PROCEDURE, EQUIPMENT, DESIGN CHANGES, ETC.) THAT COULD BE USED TO REDUCE THE USE OF THE HAZARDOUS MATERIALS OR PRODUCTS. THE PROPOSED SYSTEM MODIFICATIONS CANNOT ADVERSELY AFFECT THE SYSTEM PERFORMANCE.

PROCESS	PROPOSED SYSTEM MODIFICATIONS

WORKSHEET 12
RE(. CLING/REGENERATION ALTERNATIVES

PROJECT LOCATION: _____

IN THE TABLE BELOW IDENTIFY ANY REGENERATION/RECYCLING POSSIBILITIES FOR THE HAZARDOUS WASTE PRODUCDED BY EACH PROCESS. EXAMPLES INCLUDE, REUSING THE MATERIAL FOR ITS ORIGINAL PURPOSE, USING THE MATERIAL FOR A LOWER QUALITY PURPOSE, SELLING THE MATERIAL AND BURNING THE MATERIAL FOR HEAT RECOVERY. IF THE MATERIAL IS TO BE REUSED IT MUST BE PROVEN THROUGH R&D NOT TO ADVERSELY

PROCESS	PROPOSED SYSTEM MODIFICATIONS

WORKSHEET 13

IDENTIFICATION OF EQUIPMENT/OPERATIONAL CHANGES

PROJECT LOCATION: _____

PROCESS AND ALTERNATIVE: _____

List under each heading any requirements that are added or subtracted because of the implementation of this alternative for the process listed above.

REQUIREMENTS/CHANGES	DESCRIPTION
Equipment:	
Utilities:	
Material Handling:	
Engineering/Design:	
Facilities:	

WORKSHEET 13
(CONTINUED)

IDENTIFICATION OF EQUIPMENT/OPERATIONAL CHANGES

PROJECT LOCATION: _____
PROCESS AND ALTERNATIVE: _____

REQUIREMENTS/CHANGES	DESCRIPTION
Training:	
Personnel:	
Analytical:	
Testing:	
Transportation:	
Disposal:	

WORKSHEET 13
(CONTINUED)

IDENTIFICATION OF EQUIPMENT/OPERATIONAL CHANGES

PROJECT LOCATION: _____
PROCESS AND ALTERNATIVE: _____

REQUIREMENTS/CHANGES	DESCRIPTION
Management:	
Other:	

WORKSHEET 14

LIFE CYCLE COST ANALYSIS INFORMATION

PROJECT LOCATION: _____

PROCESS: _____

Identify the alternative and list the applicable information for each.
This information will be used during the life cycle cost analysis.

	Alternative	Alternative	Alternative	Alternative
Economic Life				
Discount Rate				
Inflation Rate				

WORKSHEET 14.0

PHASE 0 - CONCEPT EXPLORATION AND DEVELOPMENT

LIFE CYCLE COST ANALYSIS

PROJECT LOCATION:_____

PROCESS:_____

COST ITEMS	BASE COST	INCREMENTAL INVESTMENT AND OPERATION COSTS							
		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE	
		INV	OP	INV	OP	INV	OP	INV	OP
1. LEGAL AND ENVIRONMENTAL A. OTHER:_____									
2. MANAGEMENT A. PROGRAM B. CONTRACT C. OTHER:_____									
3. DESIGN A. OTHER:_____									
4. OTHER:_____									
SUBTOTAL PHASE 0									

Notes:

1. Complete base cost column only if known or needed
2. For the preliminary analysis cost units should be entered in the incremental cost column. For the detailed analysis, dollar values should -

WORKSHEET 14.1
PHASE 1 - DEMONSTRATION AND VALIDATION
LIFE CYCLE COST ANALYSIS

PROJECT LOCATION:_____
PROCESS:_____

COST ITEMS	BASE COST	INCREMENTAL INVESTMENT AND OPERATION COSTS							
		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE	
		INV	OP	INV	OP	INV	OP	INV	OP
1. MANAGEMENT A. PROGRAM B. CONTRACT C. OTHER:_____									
2. PROCUREMENT A. MATERIALS B. EQUIPMENT C. PROTOTYPE HARDWARE/ SOFTWARE D. OTHER:_____									
3. ENGINEERING A. PROFESSIONAL SERVICES B. INTEGRATION AND TESTING C. LOST PRODUCTIVITY D. OTHER:_____									
4. LEGAL & ENVIRONMENTAL A. SECURITY B. GENERAL INSPECTTION C. CONTINGENCY PLAN AND EMERGENCY PROCEDURES D. MANIFEST SYSTEM, RECORD KEEPING, REPORTING E. FACILITY CLOSURE AND POST CLOSURE REQUIREMENTS F. OTHER:_____									
5. OTHER:_____									
SUBTOTAL PHASE 1									

Notes:

1. Complete base cost column only if known or needed.
2. For the preliminary analysis cost units should be entered in the incremental cost column. For the detailed analysis, dollar values should

WORKSHEET 14.2

PHASE 2 - ENGINEERING MANUFACTURING AND DEVELOPMENT

LIFE CYCLE COST ANALYSIS

PROJECT LOCATION:_____

PROCESS:_____

COST ITEMS	BASE COST	INCREMENTAL INVESTMENT AND OPERATION COSTS							
		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE	
		INV	OP	INV	OP	INV	OP	INV	OP
1. MANAGEMENT A. PROGRAM B. CONTRACT C. OTHER:_____									
2. PROCUREMENT A. MATERIALS B. OTHER:_____									
3. HANDLING A. PERSONNEL AND ADMIN. B. STORAGE/DISTRIBUTION C. INVENTORY MANAGEMENT D. REDUCED PRODUCTIVITY E. OTHER:_____									
4. TRANSPORTATION A. PACKAGING B. OTHER:_____									
5. TRAINING A. SPECIAL TRAINING B. LOST TIME DURING TRAINING C. REDUCED PRODUCTIVITY D. OTHER:_____									
6. DISPOSAL/RECYCLE A. RECYCLE EQUIPMENT B. DISPOSAL/RECYCLE COSTS C. GENERAL WASTE ANALYSIS D. OTHER:_____									
7. MEDICAL A. SURVEILANCE PROGRAM B. LOST TIME DUE TO EXAMS C. LOST TIME DUE TO ILLNESS/ INJURIES D. REDUCED PRODUCTIVITY E. OTHER:_____									

WORKSHEET 14.2

PHASE 2 - ENGINEERING MANUFACTURING AND DEVELOPMENT

LIFE CYCLE COST ANALYSIS

PROJECT LOCATION:_____

PROCESS:_____

COST ITEMS	BASE COST	INCREMENTAL INVESTMENT AND OPERATION COSTS							
		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE	
		INV	OP	INV	OP	INV	OP	INV	OP
8. LEGAL & ENVIRONMENTAL A. SECURITY B. GENERAL INSPECTION C. CONTINGENCY PLAN AND EMERGENCY PROCEDURES D. MANIFEST SYSTEM, RECORD KEEPING, REPORTING E. FACILITY CLOSURE AND POST CLOSURE REQUIREMENTS F. OTHER:_____									
9. PERSONAL PROTECTIVE EQUIPMENT A. OTHER:_____									
10. SUPPORT FACILITIES A. OTHER:_____									
11. SUPPORT EQUIPMENT A. OTHER:_____									
12. OTHER:_____									
SUBTOTAL PHASE 2									

Notes:

1. Complete base cost column only if known or needed.
2. For the preliminary analysis cost units should be entered in the incremental cost column. For the detailed analysis, dollar values should be entered.

WORKSHEET 14.3
PHASE 3 - PRODUCTION AND DEPLOYMENT
LIFE CYCLE COST ANALYSIS

PROJECT LOCATION:_____

PROCESS:_____

COST ITEMS	BASE COST	INCREMENTAL INVESTMENT AND OPERATION COSTS							
		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE	
		INV	OP	INV	OP	INV	OP	INV	OP
1. MANAGEMENT A. PROGRAM B. CONTRACT C. OTHER:_____									
2. PROCUREMENT A. MATERIALS B. OTHER:_____									
3. HANDLING A. PERSONNEL AND ADMIN. B. STORAGE/DISTRIBUTION C. INVENTORY MANAGEMENT D. REDUCED PRODUCTIVITY E. OTHER:_____									
4. TRANSPORTATION A. PACKAGING B. OTHER:_____									
5. TRAINING A. SPECIAL TRAINING B. LOST TIME DURING TRAINING C. REDUCED PRODUCTIVITY D. OTHER:_____									
6. DISPOSAL/RECYCLE A. RECYCLE EQUIPMENT B. DISPOSAL/RECYCLE COSTS C. GENERAL WASTE ANALYSIS . D. OTHER:_____									
7. MEDICAL A. SURVEILANCE PROGRAM B. LOST TIME DUE TO EXAMS C. LOST TIME DUE TO ILLNESS/ INJURIES D. REDUCED PRODUCTIVITY E. OTHER:_____									

WORKSHEET 14.3
PHASE 3 - PRODUCTION AND DEPLOYMENT
LIFE CYCLE COST ANALYSIS

PROJECT LOCATION:_____

PROCESS:_____

COST ITEMS	BASE COST	INCREMENTAL INVESTMENT AND OPERATION COSTS							
		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE	
		INV	OP	INV	OP	INV	OP	INV	OP
8. LEGAL & ENVIRONMENTAL A. SECURITY B. GENERAL INSPECTION C. CONTINGENCY PLAN AND EMERGENCY PROCEDURES D. MANIFEST SYSTEM, RECORD KEEPING, REPORTING E. FACILITY CLOSURE AND POST CLOSURE REQUIREMENTS G. OTHER:_____									
9. PERSONAL PROTECTIVE EQUIPMENT A. OTHER:_____									
10. SUPPORT FACILITIES A. OTHER:_____									
11. SUPPORT EQUIPMENT A. OTHER:_____									
12. OTHER:_____									
SUBTOTAL PHASE 3									

Notes:

1. Complete base cost column only if known or needed
2. For the preliminary cost analysis cost units should be entered in the incremental cost column. For the detailed analysis, dollar values should be entered.

WORKSHEET 14.4
PHASE 4 - OPERATIONS AND SUPPORT
LIFE CYCLE COST ANALYSIS

PROJECT LOCATION:_____
PROCESS:_____

COST ITEMS	BASE COST	INCREMENTAL INVESTMENT AND OPERATION COSTS							
		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE	
		INV	OP	INV	OP	INV	OP	INV	OP
1. MANAGEMENT A. PROGRAM B. CONTRACT C. OTHER:_____									
2. PROCUREMENT A. MATERIALS B. OTHER:_____									
3. HANDLING A. PERSONNEL AND ADMIN. B. STORAGE/DISTRIBUTION C. INVENTORY MANAGEMENT D. REDUCED PRODUCTIVITY E. OTHER:_____									
4. TRANSPORTATION A. PACKAGING B. OTHER:_____									
5. TRAINING A. SPECIAL TRAINING B. LOST TIME DURING TRAINING C. REDUCED PRODUCTIVITY D. OTHER:_____									
6. DISPOSAL/RECYCLE A. RECYCLE EQUIPMENT B. DISPOSAL/RECYCLE COSTS C. GENERAL WASTE ANALYSIS D. OTHER:_____									
7. MEDICAL A. SURVEILANCE PROGRAM B. LOST TIME DUE TO EXAMS C. LOST TIME DUE TO ILLNESS/ INJURIES D. REDUCED PRODUCTIVITY E. OTHER:_____									

WORKSHEET 14.4

PHASE 4 - OPERATIONS AND SUPPORT

LIFE CYCLE COST ANALYSIS

PROJECT LOCATION:_____

PROCESS:_____

COST ITEMS	BASE COST	INCREMENTAL INVESTMENT AND OPERATION COSTS							
		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE	
		INV	OP	INV	OP	INV	OP	INV	OP
8. LEGAL & ENVIRONMENTAL A. SECURITY B. GENERAL INSPECTION C. CONTINGENCY PLAN AND EMERGENCY PROCEDURES D. MANIFEST SYSTEM, RECORD KEEPING, REPORTING E. FACILITY CLOSURE AND POST CLOSURE REQUIREMENTS F. OTHER:_____									
9. PERSONAL PROTECTIVE EQUIPMENT A. OTHER:_____									
10. SUPPORT FACILITIES A. OTHER:_____									
11. SUPPORT EQUIPMENT A. OTHER:_____									
12. OTHER:_____									
SUBTOTAL PHASE 4									

Notes:

1. Complete base cost column only if known or needed.
2. For the preliminary analysis cost units should be entered in the incremental cost column. For the detailed analysis, dollar values should be entered.

WORKSHEET 14.5

PHASE 5 - DECOMMISSIONING

LIFE CYCLE COST ANALYSIS

PROJECT LOCATION:_____

PROCESS:_____

COST ITEMS	BASE COST	INCREMENTAL INVESTMENT AND OPERATION COSTS							
		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE	
		INV	OP	INV	OP	INV	OP	INV	OP
1. MANAGEMENT A. PROGRAM B. CONTRACT C. OTHER:_____									
2. PROCUREMENT A. MATERIALS B. OTHER:_____									
3. HANDLING A. PERSONNEL AND ADMIN. B. STORAGE/DISTRIBUTION C. INVENTORY MANAGEMENT D. REDUCED PRODUCTIVITY E. OTHER:_____									
4. TRANSPORTATION A. PACKAGING B. OTHER:_____									
5. TRAINING A. SPECIAL TRAINING B. LOST TIME DURING TRAINING C. REDUCED PRODUCTIVITY D. OTHER:_____									
6. DISPOSAL/RECYCLE A. RECYCLE EQUIPMENT B. DISPOSAL/RECYCLE COSTS C. GENERAL WASTE ANALYSIS -- D. OTHER:_____									
7. MEDICAL A. SURVEILANCE PROGRAM B. LOST TIME DUE TO EXAMS C. LOST TIME DUE TO ILLNESS/ INJURIES D. REDUCED PRODUCTIVITY E. OTHER:_____									

WORKSHEET 14.5
PHASE 5 - DECOMMISSIONING
LIFE CYCLE COST ANALYSIS

PROJECT LOCATION:_____
PROCESS:_____

COST ITEMS	BASE COST	INCREMENTAL INVESTMENT AND OPERATION COSTS							
		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE	
		INV	OP	INV	OP	INV	OP	INV	OP
8. LEGAL & ENVIRONMENTAL A. SECURITY B. GENERAL INSPECTION C. CONTINGENCY PLAN AND EMERGENCY PROCEDURES D. MANIFEST SYSTEM, RECORD KEEPING, REPORTING E. FACILITY CLOSURE AND POST CLOSURE REQUIREMENTS F. OTHER:_____									
9. PERSONAL PROTECTIVE EQUIPMENT A. OTHER:_____									
10. SUPPORT FACILITIES A. OTHER:_____									
11. SUPPORT EQUIPMENT A. OTHER:_____									
12. OTHER:_____									
SUBTOTAL PHASE 5									

Notes:

1. Complete base cost column only if known or needed.
2. For the preliminary cost analysis cost units should be entered in the incremental cost column. For the detailed analysis, dollar values should be entered.

WORKSHEET 15

LIFE CYCLE COST ANALYSIS
SUMMARY TABLE

PROJECT LOCATION:_____
PROCESS:_____

LCC PHASE	INCREMENTAL INVESTMENT AND OPERATION COSTS							
	ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE	
	INV	OP	INV	OP	INV	OP	INV	OP
LCC PHASE 0								
LCC PHASE 1								
LCC PHASE 2								
LCC PHASE 3								
LCC PHASE 4								
LCC PHASE 5								
TOTAL INCREMENTAL COST								

WORKSHEET 16

IDENTIFICATION OF INTANGIBLE FACTORS

PROJECT LOCATION: _____

For each process alternative list any intangible factors that could either positively or negatively impact the decision to implement any given alternative. Intangible factors may include; public opinion, proposed or anticipated regulations, potential liability, employee satisfaction, mission objective, present Navy policy, etc. This is not a complete list and special cases (i.e., region specific) should be taken into account.

PROCESS	ALTERNATIVE	INTANGIBLE FACTORS

WORKSHEET 17

DETERMINATION OF HAZARDOUS WASTE REDUCTION POTENTIAL

PROJECT LOCATION: _____

For each process alternative determine the anticipated percentage reduction in hazardous waste production per year.

PROCESS	ALTERNATIVE	HAZARDOUS WASTE REDUCTION POTENTIAL (%)

WORKSHEET 18

IDENTIFY THE BEST-CHOICE ALTERNATIVE

PROJECT LOCATION:_____

PROCESS:_____

	Alternative	Alternative	Alternative	Alternative
Incremental Annualized Cost (+/-) (From Worksheet 15)				
Hazardous Waste Reduction Potential (%) (From Worksheet 17)				
Intangible Factors (From Worksheet 16)				

Positive cost (+) indicates a cost. Negative cost (-) indicates a savings.

Use additional sheets if there are more than 6 alternatives identified.

CHAPTER 6

HMC&M AND THE LOGISTICS REVIEW GROUP (LRG) AUDIT PROCESS

CHAPTER 6.0

"HMC&M AND THE LOGISTICS REVIEW GROUP (LRG) AUDIT PROCESS"

6.1 INTRODUCTION

Guidelines to validate the inclusion of HMC&M considerations during the acquisition process are provided in this Chapter. First, the mandate given to the LRG audit teams (through OPNAVINST 4105.3, Integrated Logistics Support Review and Appraisal) for certifying the adequacy of ILS planning, management, and execution is examined briefly. Then, the LRG Principles of Assessment are presented and the relationship between the LRG HMC&M Audit Checklist and the LRG review and appraisal process is discussed.

6.2 OVERVIEW OF THE LRG PROCESS AND CERTIFICATION PROCEDURES

OPNAVINST 4105.3 requires that ILS planning, management, and execution in support of R&D, production, and fleet introduction of new or modified systems (i.e., weapons platforms, systems, subsystems, and other equipment) be formally assessed and certified in the acquisition review process. The LRG's mandate is to perform an unbiased assessment of ILS planning, management, and execution for each acquisition review.

In addition to Navy, SYSCOM, and activity-specific acquisition logistics instructions and procedures, audit team members working with HMC&M validation will apply their working knowledge of:

- DoDD 5000.1 - Defense Acquisition
- DoDI 5000.2 - Defense Acquisition Management Policies And Procedures
- DoD 5000.2-M - Defense Acquisition Management Documentation And Reports
- DoDD 4210.15 - Hazardous Material Pollution Prevention
- DoDI 6050.5 - DoD Hazard Communication Program
- OPNAVINST 4110.2 - Hazardous Material Control And Management (HMC&M)
- OPNAVINST 4105.3 - ILS Review And Appraisal
- OPNAVINST 5000.42D - R & D Requirements Procedures
- OPNAVINST 5090.1A - Environmental And Natural Resources Program Manual
- OPNAVINST 5100.24A - Navy System Safety Program
- OPNAVINST 5000.49A - Integrated Logistics Support (ILS) In The Acquisition Process

During the audit process, audit team members will also use their knowledge of applicable standards such as:

- MIL-STD-882-B - System Safety Program Requirements
- MIL-STD-1388-1A - Logistic Support Analysis
- MIL-STD-1388-2B - DoD Requirements For A Logistic Support Analysis Record
- FED-STD-313C - Material Safety Data, Transportation Data, And Disposal Data For HAZMAT Furnished To Government Activities

6.2.1 The LRG Review and Certification Process

Principal activities during the LRG process include:

- Identifying and scheduling ILS audits prior to key milestone decision points and prior to initial deployment.
- Detailed ILS program reviews (audits) established and executed under the PM's direction.
- Documenting audit results in an LRG Audit Report.
- Presenting audit reports to the LRG for approval.
- Documenting that deficiencies identified in the Report have been corrected.
- Certification of ILS by the SYSCOM.
- Final certification approval by the DCNO Logistics.

ILS reviews for acquisition programs designated as ACAT I and II programs and selected ACAT III programs (on an exception basis) use the process and procedures under OPNAVINST 4105.3 at Milestones I, II, and III and prior to initial deployment and fleet introduction. SYSCOMs replicate the process and procedures in their review of ACAT III programs. ACAT IV logistic reviews follow procedures developed by individual SYSCOMs.

The LRG process, when executed in conjunction with HMC&M requirements, provides the Chief of Naval Operations (CNO) with a systematic method of ensuring that ILS is adequately planned, managed, and executed in each acquisition program phase and that safety, health, and environmental concerns are addressed throughout program milestones and phases.

The Team Leader (provided by DCNO (L)) establishes liaison with a Program Office, prior to scheduling an LRG audit, to discuss such items as audit scope and timing, sequence of events, PM's responsibilities in connection with the audit, audit procedures, key logistics documentation and materials required, exit criteria and post-audit procedures.

The LRG schedule (a tentative schedule of OPNAV logistics audits and LRG meetings) is then developed in coordination with cognizant Program

Sponsors and SYSCOM project offices. The schedule includes tentative dates for audit pre-briefs, the actual audits, and LRG Flag Board Meetings.

A letter is sent to the PM twenty days prior to the audit, with a detailed audit agenda, applicable checklists, and other audit information requirements. The nature and depth of review are tailored to the project life cycle phase to be audited. This specific tailoring is evident in the audit checklists applicable to the acquisition Milestones. It is very important to ensure that HMC&M considerations in the appropriate checklist(s) are provided to the PM by the LRG Team Leader.

6.2.2 The Audit Pre-brief

The Program Office provides a pre-brief to the Audit Team with the acquisition program (overview) and its ILS program one week prior to an audit. The pre-brief presentation generally includes: a system description and its operational use; program size in terms of units to be produced and dollars, milestones, and acquisition strategy; and, a planning summary for each audit area. At this meeting, the PM provides key logistics documentation to the auditors including, but not limited to:

- Operational Requirements Document
- Decision Coordinating Papers
- Acquisition Strategies
- Integrated Logistics Support Plans
- Requests for Proposals
- Statements of Work
- Contracts
- Navy Training Plans
- Depot Planning Annexes

The documentation also includes results, reports, contract deliverables, and other logistics efforts accomplished in the previous phase and documented plans for the next acquisition phase.

At this juncture, the auditors should analyze key documentation to confirm that HMC&M is being addressed in the acquisition strategies and documentation (ILSP, RFP, SOW, etc.) for the program or milestone under consideration. This analysis is critical to the success of the forthcoming audit. Working with the Team Leader, the designated auditors can use this detailed information to tailor the LRG Checklist/HMC&M Audit Checklist for validating the inclusion of HMC&M requirements.

6.2.3 Logistics Review Group Principles of Assessment

LRG audits are considered periodic "snap shots" of an ILS program prior to a major milestone. Audits should not be influenced by any programmatic considerations. The LRG provides a timely check and balance to help PMs resist pressures to defer or trade-off LCC and supportability considerations. When implementing OPNAVINST 4110.2, considerations related to the HM use and control are especially important.

Decisions by appropriate authorities to proceed, not to proceed, or to restructure a program, should include consideration of all pertinent factors, including HMC&M. De facto exceptions to established logistics policy to proceed with an acquisition program which has significant ILS deficiencies (such as the use of a HM for which there is no substitute),

must be reflected in the decision record. Appropriate steps must be taken to resolve deficiencies and reduce associated risks.

The conclusions and recommendations contained in LRG audit reports are balanced against all other decision factors and Navy priorities. Consideration of HMC&M in the acquisition process adds another dimension to the decision factors.

6.3 USING THE LOGISTICS REVIEW GROUP (LRG) AUDIT CHECK-LIST FOR HMC&M

Before discussing the LRG check-lists, it is important to emphasize that OPNAVINST 4110.2 implementation has been planned to coincide with ILS phases for systems acquisitions. The Instruction's provisions are effective immediately for system acquisitions before, at, or in a status equivalent to Milestone I. Regarding system acquisitions at Milestones II, III, IV (if required) the provisions of OPNAVINST 4110.2 become effective upon the completion, submission, and approval (by CNO, N-4) of an HMC&M plan.

OPNAVINST 4110.2 provisions became effective in 36 months for existing weapon systems and equipment in service. However, all Echelon 2 commanders and commanders-in-chief must implement plans, schedules, and actions for the time-phased implementation of HMC&M for all systems and equipment under their cognizance which involve the use of HMs.

6.3.1 Tailoring Audit Checklists

LRG audit checklists are generally tailored to reflect the planning, management, and execution required for each acquisition milestone, from initial concept definition to production and deployment. The checklists, containing exploratory questions for each audit area, are used as guidance in conducting the audit.

Copies of the audit checklist(s), (including the HMC&M Audit Checklist), should be provided to each Project Office with the letter scheduling the audit (or earlier). Project offices will use these checklists to prepare for the audit and should have a completed checklist available at the audit.

6.3.2 LRG Audit Checklist for HMC&M

To document that HMC&M is being included in the system acquisition process, the DCNO (L) charged the Safety and Occupational Health Branch (OP-454, now N-451H) with the development of an LRG Audit Checklist for HMC&M (hereafter referred to as the HMC&M Checklist). The HMC&M Check-list, which was issued in April 1991, has been tested successfully and is now in use. (See APPENDIX B).

The HMC&M Checklist is designed to monitor acquisition program HMC&M requirements from pre-Milestone 0 to the initial deployment stage. Developed primarily for management type audits and appraisals, rather than as an instrument for inspections or detailed functional investigations, the HMC&M Checklist may be customized according to the program milestone and ACAT involved. The Checklist includes references to the appropriate Directive or Instruction relevant to the ILS element or program item being audited.

The HMC&M Checklist should be used in ACAT I and II audits and can serve, when suitably adapted by Echelon 2 Commands, in ACAT III and IV milestone audits. The HMC&M Audit Checklist, at the PM's option, may be incorporated into existing checklists or used in a separate and distinct audit for certification into the next phase or milestone. The auditor's review of preliminary documentation prior to the actual audit provides the basis for customizing the HMC&M audit checklist for the particular program Milestone under evaluation.

The Checklist may be used during the audit to discover HMC&M certification-dependent findings such as:

- Failure to initiate actions for PEAs and EISs.
- Failure to include a PHA in the milestone charts and schedules.
- Lack of HMC&M requirements in LCC estimates and analysis.
- Deficiency in identifying requirements for substituting less HM or minimizing HW.
- Omission of system safety, health hazards, and environmental risks from the IPS.
- Insufficient funds to accomplish logistics tasks or acquire support resources (or no funds identified).
- Inadequate definition of HMC&M manpower/training requirements.
- Failure to incorporate a hazard and pollution prevention RDT&E plan in the appropriate ILS element.
- Failure to give appropriate weight to HMC&M requirements in RFPs, SOWs, Source Selection Criteria, and other contract provisions.

Prior to Milestone I, the audit team members must examine the MNS, if applicable, the ORD, and other relevant documents to determine if requirements to identify, minimize, control, and/or dispose of potential environmental hazards, HM, or HW are contained therein. Important questions of interest to both PMs and auditors at Milestone I include:

- Have occupational health and environmental hazard/toxicological research requirements for new or existing HM been identified?
- Has adequate funding for R&D been planned to coincide with appropriate phases and milestones?
- Does the PHA address HMC&M requirements?
- Do contractor SOWs and Source Selection Criteria ensure compliance with HMC&M requirements?
- Does the ILSP include consideration for environmental, safety, and health problems in the appropriate ILS elements?

- Does the LRFP include consideration for HMC&M across several ILSP elements, if appropriate?

- Are HM use or HM substitution supported by LCC cost estimates?

The auditor's verification that a plan/schedule for implementing OPNAVINST 4110.2 has been submitted for review and approval is especially important at Milestone I.

The IPS, a major issue-oriented document which provides the basis for the milestone decision review agenda, is part of the documentation requirements of DoDI 5000.2, PART 11, SECTION C, for ACATS I through IV and Milestone I through IV. The auditors must verify that the IPS includes system safety, health hazards, and environmental risks.

When Milestone I is reached, support plans/procedures for safe HM use, storage, and disposal and generated HW must be integrated into the logistics planning documentation, especially the ILSP, appropriate ILS elements, LSA, and supporting technical manuals and maintenance documentation. Milestone I also requires an AUL for the system or program documentation.

When moving from Milestone I to Milestone II, the auditor validates that the ILSP is updated regularly to address HMC&M issues that become part of management's decision to accept the risk of using HMs. In addition, the auditor must be sensitive to the inclusion of safeguards when HMs must be used. The auditor should certify that design alternatives to correct any HMC&M deficiencies are included and documented in the decision process.

The HMC&M plan and schedules, ILSP, and LSA must be reviewed at Milestone III to determine if HMC&M actions are being completed and integrated into the acquisition process. Funding aspects must also be examined at regular intervals to ensure adequate resources for HMC&M needs in the LRFP. The effect on major claimants, other than the PM, must be addressed.

Another important element at Milestone III is confirmation by the auditors that all technical documentation, manuals, training materials, maintenance plans, phased support plans, etc., include the requisite warnings, precautions, environmental controls, personal protective equipment, and other HMC&M compliance requirements. Adjunct responsibilities of auditors at Milestone III are: validating the adequacy of HM risk assessments and LCC; examining SOWs to ascertain if contractors are meeting HMC&M requirements, especially those related to environmental, safety, and health impacts; and, determining if the PM has developed an AUL.

AUL status must be assessed to ensure that the PEO, HMC&M Coordination Office, and NAVSUPSYSCOM are adding HMs to the Navy AUL. HM designated for shipboard use must be included on the SHML. The HMC&M Checklist (see APPENDIX B) offers details on the items that should be certified prior to system deployment.

As the acquisition program continues through the Milestones, the HMC&M Checklist continues to build on the documentation provided in hazard analyses, risk assessments, and LCC estimates, which are all applied to the decision-making process.

6.4 AUDITING HMC&M IN THE ACQUISITION LOGISTICS PROCESS

The following Guidelines have been designed to focus attention on key HMC&M compliance issues, which if omitted, could result in certification-dependent findings. Such findings must be corrected before certification to proceed to the next milestone is granted.

The HMC&M Guidelines can be used by the PM to customize the HMC&M Checklist for the system acquisition's size, complexity, and Phase/Milestone, prior to the actual audit. As a supplement to the HMC&M Audit Checklist, the Guidelines can serve as indicators of possible areas of non-compliance or deficiencies and can alert PMs to practices, conditions, and situations that are non-compliant. The Guidelines also demonstrate that judgements by the audit Team Leader(s) and auditors in determining the focus and extent of further investigation are required.

6.4.1 LRG/LSA HMC&M Audit Guidelines

GUIDELINE #1--MISSION NEED STATEMENT (MNS):

(1) The cost- and operational effectiveness analysis should describe quantitatively and qualitatively, the operational impact(s), including environmental considerations, of responding to an identified deficiency or opportunity in the manner suggested by each alternative under consideration.

(2) The MNS trade-off analysis portion should appraise environmental assessment implications and impacts on fielding and operating the weapon system and conducting realistic training.

(3) The MNS should be examined to ensure that it includes specific information on environmental, safety, and health constraints.

GUIDELINE #2--OPERATIONAL CONSTRAINTS:

(1) As an element of LCC and risks, inclusion of HMC&M is especially important concerning operational capacity needs and operational constraints. For example: peacetime Volatile Organic Compound (VOC) constraints can impede application of paints and materials needed to meet mobilization requirements, etc.

(2) The safe and controlled receipt, distribution, issuance, use, storage, shipping, and disposition of HM should be considered when determining operational constraints.

GUIDELINE #3--OPERATIONAL REQUIREMENTS DOCUMENT (ORD):

(1) The ORD should identify environmental, safety, and health constraints relating to system operation, maintenance, personnel, training, and safety limitations. Such constraints may require HAZCOM training for personnel, PPE, additional consideration for the handling and disposition of HM, etc.

(2) The identification, minimization, control, and disposition of potentially HM and HW should be shown as well as potential environmental hazards in the work/operational environment. The ORD should include objectives and minimum acceptable requirements for HMC&M associated with applicable ILS elements.

(3) Exit criteria, which are the specific minimum requirements that must be satisfactorily demonstrated before an effort or program can progress into the next acquisition phase, should address HMC&M requirements. Specific criteria should be included concerning the existence/approval of any high risk HM or HW that cannot be eliminated, mitigated, or must be accepted subject to specific review procedures.

GUIDELINE #4--NONDEVELOPMENTAL ITEM (NDI):

(1) NDIs (off-the-shelf, hardware/software items) should be assessed to determine if they were subject to test and evaluations procedures to define the level of potential risks, particularly those relating to occupational health, system safety, and the environment.

(2) A determination should be made if a thorough safety assessment for the intended use was performed and documented before purchase.

(3) NDIs should be subject to the same degree of HMC&M considerations as items acquired through the normal concept development, demonstration, development, and production phases.

GUIDELINE #5--RESEARCH, DEVELOPMENT, TEST AND EVALUATION (RDT&E) PLANNING:

(1) Planned RDT&E studies to define environmental, safety, and occupational health requirements for any new HMs or new applications of such material should be adequately funded (Milestone I).

(2) Identified RDT&E studies and investigations that will lead to appropriate safeguards must be programmed and included in the design development (Milestone I).

(3) The system design should reduce the probability and severity of all

hazards to a level specified by the Program Office. Hazards in systems must be eliminated or controlled before Milestone III, Production Approval.

GUIDELINE #6--PRELIMINARY HAZARD ANALYSIS (PHA):

(1) A PHA should be documented during Phase O and prior to Milestone I. The PHA should be performed in accordance with OPNAVINST 5100.24A, through a tailored application of MIL-STD-882, Task 202. Risks associated with any identified hazards must be formally documented using MIL-STD-882 as a guide for establishing criteria for defining and categorizing "high" and "serious" risks.

(2) The PHA must address all known HMC&M requirements. The requirements of MIL-STD-1388-1A and MIL-STD-1388-2B on environment, safety, HM, HW, and toxic agents must also be satisfied.

(3) Auditors should take cognizance of Section 6, OPNAVINST 5100.24A (Navy System Safety Program) which contains mandatory requirements for the identification, evaluation, and elimination of hazards prior to systems production, construction, and deployment of all ACAT I and II programs.

GUIDELINE #7--ENVIRONMENTAL PLANNING/ANALYSIS:

(1) Prior to Milestone I, the PM must incorporate consideration for potential environmental hazards and impacts into each system alternative and address initial HMC&M requirements.

(2) All potential environmental effects must be identified in detail adequate to be integrated with both economic and technical analyses.

GUIDELINE #8--PROGRAMMATIC ENVIRONMENTAL ANALYSIS (PEA):

(1) PEAs begin immediately after Milestone I and must contain descriptions of potential environmental impacts of each alternative throughout the system life cycle, potential mitigation of adverse impacts, and how the mitigation would affect scheduling, siting alternatives, and program costs.

(2) Available documentation should be checked to ensure that a PEA has been performed (regardless of program classification). Unless there is a "Finding of No Significant Impact," the auditor will validate that a PEA has been completed prior to the next milestone decision point.

GUIDELINE #9--TEST AND EVALUATION MASTER PLAN (TEMP):

(1) Health hazards and safety-critical issues must be included in the TEMP. If special safety tests and evaluations have been prepared, confirm that the results related to HMC&M are integrated into the TEMP.

(2) DoDI 5000.2, Part 6, Section I requires that environmental, safety and occupational health impacts be carefully evaluated--this includes manufacturing, maintenance and disposal.

(3) Health hazards and safety lessons learned from predecessor systems should be addressed during Phase I.

GUIDELINE #10--INTEGRATED PROGRAM SUMMARY (IPS):

(1) The IPS should be reviewed to ensure inclusion of HMC&M.

(2) The type of environmental analysis conducted (EIS, environmental assessment, etc.) should be reviewed to validate that the concept/design alternative chosen will meet HMC&M requirements and is environmentally preferable.

(3) If appropriate, examine the Environmental Analysis (Annex E) of the IPS to verify that any system safety, health hazards, and environmental risks are clearly identified.

(4) From the environmental risk analysis, ascertain if there are anticipated risks that cannot be mitigated, what steps are being taken to identify future impacts of such risks, and if a formal decision has been made to accept such risks.

GUIDELINE #11--HAZARDOUS MATERIAL CONTROL AND MANAGEMENT (HMC&M):

(1) A plan and schedule for the implementation of OPNAVINST 4110.2, HMC&M, should be submitted to the CNO (N-4) for review and approval at or before Milestone I.

(2) At Milestone I, confirm that HMC&M plan development includes specific actions to control the acquisition, handling, storage, transportation, and disposition of HM prior to subsequent Milestones.

(3) At Milestone I, determine if the PM has prepared an AUL with applicable references in the program documentation. At subsequent Milestones, confirm that the AUL has been updated for the system and its equipment.

(4) Ensure that MSDSs are obtained and incorporated into the HMIS for each HM on the Navywide AUL.

(5) Review the LRG HMC&M Audit Checklist for the appropriate ACAT and specific program milestone to ensure that HMC&M items on the

Checklist are addressed during the audit (AUL, LRFP, EIS, PHA, etc.).

(6) Review the HMC&M Plan (including the ILSP/LSA) at subsequent Milestones to ensure that it is being updated to reflect any new requirements and to validate that specific actions concerning HMC&M will be completed by initial system deployment.

(7) Determine if contractors are complying with HMC&M requirements called for in SOWs, technical documentation, LSAR data, and other contractual documents.

(8) At initial deployment, verify that any authorized HM is on the Navy AUL, and for forces afloat, on the SHML.

(9) At initial deployment, validate that HMC&M plans and documentation have been updated to reflect any changes in HM use. Analyze program documents to identify deficiencies in HMC&M training materials, problems associated with HW disposal, inadequacies of PPE, and lack of permanent records of identified hazards and close out actions.

(10) Verify that post-production maintenance support by contractors provides SOW requirements for HMC&M, including precautionary measures and disposal requirements.

GUIDELINE #12--LIFE CYCLE COSTS:

(1) Inclusion or substitution of HMs must be supported by LCC estimates on a magnitude equivalent to the system acquisition under evaluation.

(2) Economic analyses for costs associated with HM use and potential alternatives should be included in accordance with the requirements of DoDI 5000.2, DoDD 4210.15, and OPNAVINST 4110.2.

(3) Determine if the costs of using materials and processes requiring special controls, permits, and waste emission controls have been estimated and included as part of the LCC estimates.

(4) The effects that future environmental problems may have on projected costs, defense performance, future liability, as well as funding requirements, should be included.

GUIDELINE #13--LOGISTICS RESOURCE AND FUNDING PLAN (LRFP):

(1) Review the LRFP to document that total ILS resource requirements will have the necessary fiscal support throughout the acquisition life cycle and are reflected in the POM.

(2) Using the LRFP as a baseline document, validate that there is sufficient claimant and sponsor

commitment to meet the support requirements (including HMC&M) from programmed, budgeted, and appropriated funds as reflected in the document.

(3) Use the LRFP to determine if all Commanders of Echelon 2 commands, SYSCOMs, and designated PMs are meeting their responsibility to develop, establish, and fund programs necessary for facilities and operations to comply with HMC&M standards and regulations cited in OPNAVINST 4110.2.

(4) Funding to meet HMC&M requirements should be identifiable even when integrated into several ILSP elements.

(5) The LRFP should contain adequate information regarding whether affected fleet commanders, shore activities, and other commands affected by HMC&M introduction have been notified and provided sufficient budgetary information essential to meeting HMC&M responsibilities.

GUIDELINE #14--INTEGRATED LOGISTICS SUPPORT PLAN (ILSP):

(1) The ILSP should contain information on HM or processes being considered and their unique characteristics, which are deemed essential to a system's operational capability. Ensure that the requirements of DoDI 5000.2, PART 6, SECTION I are being addressed.

(2) Ensure that PMs are cognizant of Section 6, OPNAVINST 5100.24A (Navy System Safety Program) which contains mandatory requirements for the identification evaluation, and elimination of hazards prior to systems production, construction, and deployment.

(3) A plan to determine the suitability of less HM should be included, along with procedures for incorporating hazards prevention and precautions into manuals, technical orders, and system documentation. How training requirements are to be established and met must also be described.

(4) Procedures should include incorporating OPNAVINST 4110.2 requirements for the preparation, submittal, and implementation of an HMC&M program. The interface of HMC&M with configuration control, personnel, facilities, etc. should be addressed.

(5) Milestone charts and schedules should contain completion dates for HMC&M actions (e.g., PHA, operation hazard analysis, identification, selection, and approved use of HM etc.). Establishment of design requirements for HM and HW handling facilities and disposal operations should be included.

(6) Provisions for the receipt and evaluation of HM or new materials not previously used in similar systems should be included.

(7) When a system acquisition involves new or untested HM, a separate hazard investigation or an R&D plan should be produced and incorporated into the ILSP.

(8) Logistics management should include participation by a formally appointed Hazardous Material Control Committee for the particular system. Provisions for using support from specialty organizations (Navy Energy and Environmental Support Activity, Naval Civil Engineering Laboratory, etc.) should be included.

(9) HMC&M requirements should be incorporated into SOWs for acquisition contracts and in Source Selection Criteria to ensure that the fundamental requirements of HMC&M are included in systems and documentation (manuals, instructions, etc.) developed by support contractors.

(10) The ILSP design interface portion should include provisions for incorporating the requirements of OPNAVINST5100.24A, OPNAVINST 4110.2, and MIL-STD-1388-1A. Also, information should be provided on incorporating HMC&M considerations into systems and equipment engineering and design processes as well as other ILS elements.

(11) A concerted effort to anticipate and satisfy exit criteria and other audit questions related to HMC&M at Milestone decision reviews should be ensured during the ILSP development.

GUIDELINE #15--MAINTENANCE PLANNING ELEMENT:

(1) HMC&M requirements associated with maintenance activities and functions should be identified for the operational environment.

(2) Environmental requirements such as HM control, HW minimization, and control of environmental pollutants should be included in the maintenance planning element through the LSA process.

(3) LSA (MIL-STD-1388-1A) requirements such as Task 301, "Functional Requirements Identification," and Task 401, "Task Analysis," are fundamental to this function and must be specified in the ILSP, contract SOWs, and other contract documents.

(4) MIL-STD-882B, Task 202, "Preliminary Hazard Analysis," and Task 206, "Occupational Health Hazard Assessment," must identify hazards in maintenance functions and must be included in the ILSP and contract documents.

(5) Maintenance Planning should include HMC&M elements in Milestone and Gantt charts and actions to bring together the results of hazard assessments and approvals. A LCC estimate should accompany these decisions.

GUIDELINE #16--MANPOWER AND PERSONNEL ELEMENT:

(1) Manpower and personnel requirements needed for hazards control, system safety, and environmental constraints created by the inclusion of HM in a proposed weapon system should be identified during the audit process, in addition to the skills and grades required to operate and support a system over its lifetime at peacetime and wartime rates.

(2) The ILS process should include specific manpower allocations relating to environmental constraints and human factors.

(3) The requirements of DoDI 5000.2, PART 7, SECTION B should be met and documented, as required for the Phase and Milestone of the acquisition process.

(4) Adequate attention to personnel resources for hazard communications and training, HW handling procedures, emergency procedures, and hazards control should be documented by the PM.

GUIDELINE #17--SUPPLY SUPPORT ELEMENT:

(1) The audit process should validate that supply support items for PPE, emergency response for spills and accidents, and monitoring of environments, occupational hazards or other hazards, are being addressed in the supply ILS element.

(2) Restrictions or changes in HM authorization, inputs to the AUL, and storage and handling requirements and restrictions, should be examined to ensure that they meet HMC&M standards.

(3) Known or projected support resource constraints should have been identified in the MNS or the ORD, including HMC&M considerations. If appropriate, these constraints should be based on the analysis of systems currently in the inventory which satisfy similar needs.

GUIDELINE #18--SUPPORT EQUIPMENT ELEMENT:

(1) Requirements for PPE, environmental monitoring devices, toxic/HM emission detection equipment, emergency response and spill control, evaluation and control devices, specialized HM and HW laboratory items, sensors, and alarms should be satisfied in this ILSP element and confirmed during the audit process.

(2) MIL-STD-1388-1A, Task 401, "Task Analysis," which relates to the environmental impact of HMs and HW and the identification of new or critical logistics support resources, must be satisfied.

(3) HMC&M requirements associated with MIL-STD-1388-1A Task 501, concerning supportability data relating to the new system/equipment in its operational environment, should be documented.

GUIDELINE #19--TECHNICAL DATA ELEMENT:

(1) The Technical Data (TD) management plan and TD acquisition strategy and its associated technical manuals, technical orders, maintenance instructions, and similar documentation of any form must include considerations for any authorized HM and resulting HW.

(2) TD associated with the system acquisition must include information on the identification, monitoring, precautions, control, and disposal of any approved HM/HW.

(3) Data Element Definitions (DEDs) should be developed for the LSAR that relates to HMC&M. For example, DED099 - Environmental HMs considerations, DED105 - Facility Design Criteria, DED155 - Hazardous Maintenance Procedure Code, DED156 - HM Storage Cost, DED362 - Safety Hazards Severity Code, etc.

(4) Compliance with DoDI 6050.5 (HMIS) regarding MSDSs, labeling, waste disposal requirements, etc., should be documented.

(5) The LSAR report, LSA-078, Hazardous Materials Summary (DID NO. DI-ILSS-80FFF) must be included in any SOWs and CDRLs.

GUIDELINE #20--TRAINING AND TRAINING SUPPORT ELEMENT:

(1) An audit should confirm that the approved Navy Training Plan documents and justifies the planning, programming, and budgeting for both manpower and training requirements for Navy systems and equipment acquisitions.

(2) Training requirements related to HM/HW handling and precautions for operations and maintenance activities must be included.

(3) When approved HM results in new HW released through air or water emissions, revised training procedures should be incorporated into the Training Plan.

(4) Processes, procedures, techniques, and training devices concerning HM and HW approved for the system must be specified, including all relevant elements of OSHA's HAZCOM.

GUIDELINE #21--COMPUTER RESOURCE SUPPORT ELEMENT:

(1) This ILSP element should be reviewed to ensure that input/output data on LCC, HMC&M-related data, and hazard tracking are provided and updated throughout the acquisition process.

(2) Interface requirements between HMC&M elements and the Computer Assisted Acquisition Logistic Support (CALS) program should be identified by the PM and properly documented.

(3) MIL-STD-882B, Task 105, "Hazard Tracking and Risk Resolution," should be imposed on support contractors, with contractors maintaining a centralized file or document called a "hazard log."

GUIDELINE #22--FACILITIES ELEMENT:

(1) Primary HMC&M facility issues should be examined, including the preliminary environmental analysis prior to Milestone I and the PEA prior to subsequent Milestones.

(2) HMC&M tasks associated with elements that affect facility citing, environmental requirements, pollution prevention, and compliance with Federal, State, and local environmental codes, standards, and regulations should be validated.

(3) MIL-STD-882B, Task 210, "Safety Compliance Assessment," must be implemented in SOWs of the system support contractors.

(4) Costs for construction, and operation and maintenance of environmental control facilities should be included in LCC estimates.

(5) Plans and procedures for accomplishing design requirements for HM storage, HW storage/disposal, emissions controls, waste treatment, OSHA required control measures, Clean Air Act (CAA) MACT requirements, and waste control requirements associated with EPA's water priority pollutants should be clearly identifiable.

GUIDELINE #23--PACKAGING, HANDLING, STORAGE, AND TRANSPORTATION (PHST) ELEMENT:

(1) PHST should include environmental considerations, equipment preservation requirements for short and long-term storage, and transportability.

(2) The PHST element should address minimization of hazards and resulting production of HW and inclusion of emergency response equipment, PPE, and communication requirements for transportation accidents involving HM or HW.

(3) Requirements for transportation equipment, handling equipment, specialized packaging, and HMC&M equipment as well as notification of appropriate DoD, DON, and civil authorities for spills and accidental releases must be included.

(4) Disposal requirements and costs should be an input to any trade-off analysis involving HMs and should be documented.

GUIDELINE #24--DESIGN INTERFACE ELEMENT:

(1) Results, conclusions, and actions on hazard and environmental analyses conducted during the design process should be validated.

(2) Actions to document and track hazards and environmental issues from the earliest identification through approved design measures to eliminate or mitigate the hazards should be incorporated in the program.

(3) The relationship of pollution prevention needs (environmental, system safety, and occupational safety and health issues) to readiness and support must also be documented in this element.

(4) MIL-STD-882B, Task 105, "Hazard Tracking and Risk Reduction" and MIL-STD-1388-1A, Task 103, "Program and Design Reviews," are important ways in which to address HMC&M. Application and incorporation of these Tasks should be verified.

(5) Residual hazards associated with storage, transportation, use, and disposal of HM/HW must be identified, described, and documented.

(6) Prior to Milestone III, the LRG review process should indicate that all identified hazards have been eliminated or controlled at levels acceptable to the Navy. Where remaining risks are at a high or significant level, appropriate approvals should be documented.

GUIDELINE #25--LOGISTIC SUPPORT ANALYSIS:

(1) The LSA process should be analyzed to ensure that MIL-STD-1388-1A and MIL-STD-1388-2B (DoD Requirements For A Logistic Support Analysis Record) on environment, safety, HM/HW, and toxic agents will be satisfied during the acquisition phases by the performing activity or contractor support services.

(2) Task 103, Program and Design Reviews--the audit should certify that LSA supportability and supportability-related design requirements will be achieved, including HMC&M considerations. Assessment items must include supportability, cost, and readiness drivers, and new or critical ILS requirements. Subsection 103.2.2 also requires additional agendas for the identification of supportability-related design recommendations (e.g., cost savings, maintenance burden, safety or health hazard reduction, etc.).

(3) Task 201, Use Study--this Task documents pertinent supportability factors related to the new system/equipment's intended use. The data should include, but not be limited to, environmental requirements such as HMs, HW, and environmental pollutants.

(4) Task 204, Technological Opportunities--design opportunities to improve supportability characteristics and requirements in the new system or equipment must be identified and evaluated. Technological advances which may reduce logistic support resource requirements, costs, environmental impact, or enhance system readiness should be identified.

(5) Task 205, Supportability and Supportability-Related Design Factors--supportability characteristics resulting from alternative design and operational concepts and supportability-related design objectives for the new

system/equipment should be established and included in program approval documents, system/equipment specifications, other documents, or contracts, as approved. Under Subsection 205.2.5, design constraints should address those related to HM use, HW, and environmental pollutants that may result from system operation and disposal.

(6) Task 301, Functional Requirements Identification--the LRG audit should confirm that HM use, waste generation, air and water pollutants release, and environmental impacts associated with tasks required to operate and maintain the system in its intended environment are clearly identified. The LSA process should certify planned actions to mitigate such hazards.

(7) Task 401, Task Analysis--each operation and maintenance task requirement identified for the new system/equipment (Task 301) should be analyzed to determine the environmental impact of HM, HW generation, pollutants release, etc. New or modified logistic support resources required as a result of HM use should be documented in the LSAR.

(8) Task 501, Supportability Test, Evaluation, and Verification--this Task assesses the achievement of specified supportability requirements, identifies reasons for deviations from projections, and identifies methods of correcting deficiencies and enhancing system readiness. The assessment should show that environmental impacts as well as HM control and management have been taken into consideration.

GUIDELINE #26--USER LOGISTICS SUPPORT SUMMARIES (ULSS):

(1) The LRG audit should verify that the ULSS document (if applicable) includes incorporation of HMC&M in contractors' SOWs, source selection criteria, and system specifications.

(2) The ULSS should document that HMC&M requirements are included in final technical manuals, supply support documents, planned and corrective maintenance procedures, training materials, drawings, depot maintenance, and contractor support.

(3) Procedures should be documented that allow for feedback or lessons learned from deficiencies identified during initial deployment relating to the HMC&M requirements.

(4) Updating of the post-production ILS plans should be documented, particularly as they relate to HM use, handling, and disposal.

GUIDELINE #27--PLANNING AND CONTROL:

(1) The planning and control system should include provisions for HM identification and tracking throughout the entire system development. Hazards should be tracked until they are eliminated or controlled.

GUIDELINE #28--RELIABILITY AND MAINTAINABILITY:

(1) Inclusion of HMs can affect maintainability. Objectives should be documented which include establishing alternatives for proposed HM (e.g., substitution, restriction at supply levels, recycling, etc.).

GUIDELINE #29--LIFE CYCLE SURVIVABILITY:

(1) Impacts of HM and survivability, while not readily apparent, need to be considered as integral to the overall acquisition logistics strategy.

(2) Including hazards as part of a system may be necessary. For example, highly corrosive materials can/do input on mean-time-to-failure, mean-time-to-repair, etc. HM leaks can result in significant down time. Justification for HM use should be validated in the ILSP, LSA, etc.

GUIDELINE #30--MANUFACTURING PROCESSES:

(1) Product design and associated manufacturing risks must be assessed and documented throughout all program phases, commencing with Milestone I.

(2) Assessments should include evaluations of HM/HW involved, substitutes and, proposed and alternative methods of production to reduce HM/HW.

(3) If HMs cannot be eliminated, then the required assessments and approval called for in DoDI 5000.2, PART 6, SECTION I, must be accomplished.

GUIDELINE #31--PRODUCTION ENGINEERING AND PLANNING:

(1) The use of HM and environmental impact implications should be addressed and documented in production engineering and planning.

(2) Impacts on manufacturing technologies may include changes in environmental requirements (CAA Amendments, MACT standards, and OSHA requirements for engineering controls). Potential costs or delays in delivery associated with such changes should be included in planning documents.

6.4.2 Conducting the LRG Audit

Key ILS elements reviewed during the audit include budget and funding, ILS management, and HMC&M requirements. HMC&M auditors are responsible for identifying all deficiencies pertaining to the use, control, and disposition of HM which may have an impact on the acquisition of support resources, on LCC, or which degrade operational readiness.

Audit checklists (including the HMC&M Audit Checklist) will be used to confirm that, at the appropriate Milestone, PMs and LEMs have clearly defined action plans for meeting occupational health and environmental hazard requirements during system acquisition. Determination of

whether HMC&M issues are being addressed satisfactorily will become part of the audit record.

Upon audit completion, the Team Leader prepares the first draft of a LRG report which is then provided to the PM as part of the program management debrief. The Team Leader's assessment of the certification dependency of each finding, recommendations concerning logistics certification, and program continuation are included.

The ILS Audit Summary contains a synopsis by major audit areas, a matrix of findings, and individual findings. Certification-dependent findings, which are noted on the matrix of findings, are those deficiencies which may have major impact on the costs or adequacy of support. Findings of deficiencies will normally be based on existing logistics policy and direction appropriate for a particular development phase or milestone.

In instances where compliance with applicable policy may be considered counterproductive, findings of deficiency are generally based upon the documented rationale of the auditor, with reference to related policy documents, whenever possible. Such findings of judgement receive the closest scrutiny by the LRG and normally contain policy recommendations.

6.4.3 The Final Report and Certification

The Team Leader will debrief the PM and discuss the draft LRG report. At this time, the PM corrects the data and facts in the report, obtains the rationale for the findings, and indicates agreement or disagreement with the findings and overall recommendations of the report. The Team Leader then prepares a second draft LRG report which is provided to the LRG chairperson and members approximately one week in advance of an LRG meeting.

The approved report and certification statement are distributed to LRG members, the cognizant systems commander, the cognizant program office, CINCPACFLT, CINCLANTFLT, and other interested offices. An appendix to the report is prepared by the Team Leader to document actions directed by the LRG with respect to the draft report (e.g., findings or recommendations added, deleted or revised). Some findings that may require correction include:

- Have mission/operational readiness requirements and logistic support systems performance requirements been appropriately identified, justified and satisfied?
- Have logistics problem areas and associated risks been identified and solutions addressed?
- Have adequate logistics tradeoffs and analyses been conducted to optimize support alternatives?

After certification-dependent findings (deficiencies) identified in the Final Report are corrected through a Plan of Action and Milestones (POA&M), ILS certification will be recommended by the SYSCOM and then reviewed and approved by the DCNO (L).

APPENDIX A

GLOSSARY

GLOSSARY

Acquisition--Acquiring supplies or services (including construction) by contract with Navy funds for Federal Government use through purchase or lease, whether the supplies or services are already in existence or must be created, developed, demonstrated, and evaluated.

Acquisition Category (ACAT)--Categories established to facilitate decentralized decisionmaking and execution compliance with statutorily imposed requirements.

Acute Exposure--Exposure to chemicals absorbed by inhalation, dermally, or by ingestion with the duration of total exposure measured in seconds, minutes, or hours. As applied to ingestion, it means a single dose.

Auto-ignition Temperature--Minimum temperature at which a flammable gas or vapor/air mixture will ignite from its own heat or a contacted heated surface without the use of a spark or flame.

Bioaccumulation--Tendency of a material to accumulate in specific tissues or organs of an exposed organism.

Bioconcentration--Food chain process where the dose level increases in organisms higher up the food chain.

Budget--A planned program for a fiscal period in terms of: estimated costs, obligations, and expenditures; source of funds for financing, including reimbursement anticipated and other resources to be applied; and explanatory and workload data on the projected programs and activities.

Carcinogens--Substances which are known to cause, or are suspected of causing, cancer.

CAS #--The Chemical Abstracts Service Registry Number (CAS #) is assigned to a material by the American Chemical Society's Chemical Abstracts Service to identify materials without the confusion and error frequently found in chemical and trade names.

Chemical Formula--The chemical or molecular formula designates the elemental composition of the material and its basic structure.

Chemical Name--The name derived from the chemical formula using the standard nomenclature of the American Chemical Society's Chemical Abstracts Service. Other names include trade names and the manufacturer's product name and number.

Chronic Exposure--Exposures of long duration and as applied to dermal and inhalation cover prolonged or repeated exposures with durations of days, months, or years. With ingestion, it means repeated doses of the chemical for days, months, or years.

Computer-Aided Acquisition and Logistic Support (CALS)--CALS represents the transition to integrated product development using computer-aided engineering, design, and manufacturing (CAE/CAD/CAM) applications.

Cost Drivers--Cost factors contributing a significant percentage to the total cost of hazardous materials.

Cost Effectiveness--A measure of the operational capability added by a system as a function of its life cycle cost.

Cost Factor--As used in this document, a cost factor is any factor affecting the cost of hazardous material management and control. DoDD 4210.15 defines cost factors as "the expenses and cost avoidances associated with hazardous materials that may be reduced to monetary terms, which includes future liability."

Design Interface--Relationship of logistics-related design parameters, such as reliability and maintainability, to readiness and support resource requirements.

Development Options Paper (DOP)--Document prepared by a development or engineering activity in which alternative approaches to achieve a capability are presented.

Economic Analysis--As defined in DoDD 4210.15 and applied to this document: "An evaluation of the costs associated with the use of hazardous material and potential alternatives, which is conducted in accordance with DoD Instruction 7041.3."

Ecosystem and Ecology--Ecosystem is defined as all the living organisms and the non-living matter with which they interact (eat, breath, walk on, etc.) in a given area or environment, e.g., "this isolated island" or "all coral reefs." Ecology is the study of ecosystems.

Environmental Hazards--To determine an environmental hazard, one must evaluate factors such as: the toxicity of the material, the quantity of the material used, how the material is used, and how can/will it enter the environment.

Excess Hazardous Materials (EHM)--Ready-for-issue excess material classified as HM and no longer needed by the generating activity.

Exit Criteria--Program specific accomplishments that must be satisfactorily demonstrated before an effort or program can progress further in the current acquisition phase or transition to the next acquisition phase.

Flammable Range--Range of flammable vapor or gas/air mixture between the upper and lower flammable limits also referred to as the "explosive range."

Flash Point--Minimum temperature at which a material (liquid) gives off sufficient vapor to form an ignitable mixture with the air near the surface of the liquid.

Gantt Chart--Chart used for showing planned events and processes over time and capable of comparing planned versus actual accomplishments (often called a milestone chart).

Hazard Communication (HAZCOM)--A phrase and acronym derived from 29 CFR 1910.1200, the OSHA Hazard Communication Standard, that, when used as a noun or an adjective, means a requirement or requirements related to the standard. The performance elements of the standard involve the following: a list of

hazardous chemicals, MSDSs, labels and other forms of warning, personnel training, non-routine tasks, contractor employers and employees, personnel accessibility to the list of chemicals and MSDSs, and a HAZCOM program plan.

Hazardous Chemical--Any chemical that is a physical hazard or a health hazard per 29 CFR 1910.1200(c) and, with some exceptions, as specified in the Community Right to Know Law of 1986 (Superfund Amendments and Reauthorization Act (SARA), Title III). (See hazardous material).

Hazardous Material (HM)--Any material that:

a. Is regulated as a hazardous material per 49 CFR 173.2, or

b. Requires a Material Safety Data Sheet (MSDS) per 29 CFR 1910.1200, or

c. During end use, treatment handling, packaging, storage, transportation, or disposal meets or has components which meet or have the potential to meet the definition of a hazardous waste as defined by 40 CFR 261 Subparts A, B, C, or D.

Hazardous Material Control and Management (HMC&M)--The HMC&M program, implemented under OPNAVINST 4110.2, minimizes hazards to life, property, and the environment and results in savings in manpower, facilities, and supplies associated with production and maintenance during the entire life cycle of a system.

Hazardous Material Information System (HMIS)--A computer-based information system developed to accumulate, maintain, and disseminate important characteristics and manufacturers' data on hazardous materials which exist throughout the DoD. The Defense Logistics Agency manages the DoD HMIS and maintains a computerized central repository of data on all hazardous material purchased for use within DoD.

Hazardous Material Pollution Prevention (HMPP) Plan--Typical plan of action and milestones outlining responsibilities and procedures for analyzing existing operations or processes for waste minimization potential; a method for funding waste reduction projects; a process for subordinate commands to report data that measures progress; a commitment to information exchange; and a policy of cooperation with public agencies involved in waste reduction, pollution prevention, or waste minimization.

Hazardous Material Turned in for Disposal (HMTID)--A ship's unusable HM awaiting transfer to a shore activity for disposal. HMTID may be EHM or HW.

Hazardous Material Turned Into Store (HMTIS)--A ship's usable HM in excess of needs and awaiting transfer to a shore activity.

Hazardous Substance (HS)--Any hazardous material that, because of its quantity, concentration, or hazardous properties, may pose a substantial hazard to human health or the environment when purposely released or accidentally spilled. (See hazardous material.)

Hazardous Waste (HW)--Any discarded or abandoned hazardous substance as defined in 40 CFR 261 or applicable state

regulations where the state has been granted enforcement authority by the Environmental Protection Agency (EPA). It may include any discarded liquid, semi-solid, solid, or containerized gaseous material.

Hazardous Waste Manifest--Shipping document which must originate with and be signed by the HW generator and EPA permit holder having a Resource Conservation and Reclamation Act (RCRA) Identification Number before the HW may be transported or offered for transportation off the installation.

Hazardous Waste Minimization (HAZMIN)--Consists of three parts: avoiding HW generation by minimizing and controlling HM acquisition and use, and by applying best management, engineering, and equipment to Navy processes and procedures; recycling HW to return it to a ready-for-use state; and treating HW to reduce the volume or to reduce it to a non-hazardous state.

ILS Manager--A functional title reserved for the individual who is responsible for bringing together all plans and requirements for each ILS element in a program's consolidated support program. The term "Assistant Program Manager for Logistics" (APML) and "ILS Manager" (ILSM) are considered synonymous.

Incremental Costs--As used in this document, incremental costs refer to the difference in cost for each cost factor between implementing a pollution prevention alternative and maintaining the present situation (baseline).

Initial Operating Capability (IOC)--The first attainment of the capability to employ and support an equipment or system, including an adequately trained, equipped, and supported military unit or force.

Intangible Costs--Cost factors whose consequence cannot be quantified. DoDD 4210.15 defines intangible costs as "influences bearing on the use of effects of hazardous material, which may not be reduced to monetary terms."

Integrated Logistics Support (ILS)--A disciplined, unified, and iterative approach to the management and technical activities necessary to: integrate support considerations into system and equipment design; develop support requirements that are related consistently to readiness objectives, to design, and to each other; acquire the required support; and provide the required support during the operational phase at minimum cost.

Integrated Logistics Support Plan (ILSP)--Documents the management approach, decisions, and plans associated with logistics planning efforts for a given equipment. The ILSP also contains deployment and post-production support.

Integrated Program Summary (IPS)--A DoD component document prepared and submitted to the milestone decision authority which highlights the program status and its readiness to proceed into the next phase of the acquisition cycle.

Life Cycle of a Hazardous Material--Period starting when the use or potential use of hazardous material is first encountered and

extending as long as the actual material or its after affects, such as discarded residual in a landfill, have a bearing on cost.

Life Cycle Cost--The sum total of the direct, indirect, recurring, nonrecurring, and other related costs incurred or estimated to be incurred, in the design, development, production, operations, maintenance and support of a major system over its anticipated useful life span.

Logistics Requirements and Funding Plan--Financial planning document developed and maintained by the ILS manager at program initiation to document total logistics resource requirements of the program and to ensure that these requirements are reflected in the Program Objective Memorandum (POM).

Logistics Review Group (LRG)--Performs an unbiased assessment of planning management and execution of ILS for each acquisition reviewed. The role of the LRG is analogous to that of Commander, Operational Test and Evaluation Force (COMOPTEVFOR).

Logistic Support Analysis--Systems engineering process which applies analysis and design efforts to ensure that support considerations influence design, and which results in a common database of logistics and design information from which all support products can be developed.

LRG Process and Certification Procedures--The LRG process provides the Chief of Naval Operations (CNO) with a systematic method to ensure that ILS is adequately planned, managed, and executed in each phase of an acquisition program.

Material Safety Data Sheet (MSDS)--OSHA Form 174 or an equivalent form containing the identical data elements, used by manufacturers of chemical products to communicate the chemical, physical, and hazardous properties of their product in compliance with OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Navy Training Plan (NTP)--The single document used for documenting the manpower, training, and training equipment requirements for Navy systems and equipment.

Net Present Worth--Each year's expected yearly benefits and costs multiplied by its discount factor and then summed over all years of the planning period.

Non-Developmental Item (NDI)--Hardware or software that is already developed, available, and capable of fulfilling Navy requirements thereby minimizing the need for Government-sponsored research and development programs. NDIs are usually commercial products.

Non-Recurring Costs--Investment costs which are one time costs incurred during the production of a weapon system. These costs can recur if there is a change in contractors, designs, or manufacturing processes during the production phase.

Occupational Health--Includes studies on all factors relating to work, working methods, conditions of work and the working environment that may cause diseases, injuries or deviation from health, including maladjustment resulting from chemical and physical hazards such as intoxication from inhaled dusts, fumes, gases or vapors, skin

diseases from irritating substances, or deafness from noise, mechanical risks involving machinery, etc.

Operational Acquisition--Process by which additional materials/consumables are procured in support of existing weapon systems, weapon platforms, and/or facilities.

Operational Requirements Document (ORD)--Statement of objectives for future operational capabilities needed in a major warfare or support area to meet the estimated threat. An ORD contains preliminary thresholds addressing cost, schedule, operational effectiveness and operational suitability.

Packaging, Handling, Storage, and Transportation (PHST)--The resources, processes, procedures, design considerations, and methods to ensure that all system, equipment, and support items are preserved, packaged, handled and transported properly, including environmental considerations, equipment preservation requirements for short- and long-term storage, and transportability.

Permissible Exposure Limit (PEL)--Limits of exposure established by OSHA in 29 CFR 1910.1000.

Personal Protective Equipment (PEL)--Equipment used when handling or working within the vicinity of HM or HW.

Ph and Corrosivity--The Ph of a material is its degree of acidity or alkalinity; a Ph of 0 to 7 is acidic, 7 is neutral, and >7 to 14 is alkaline. Corrosivity refers to materials with Phs at either extreme of the scale.

Physical State--The physical state of a material is a solid, liquid, or gas (generally at room temperature and pressure 25 C and 760 mm hg).

Pollution Prevention Alternative--As used in this document, a pollution prevention alternative is any material, operation, system, design or procedural change that results in a reduction of hazardous materials use and, consequently, production of hazardous waste.

Post-Production Support--Systems management and support activities necessary to ensure continued attainment of system readiness objectives with economical logistic support after cessation of production of the end item.

Primary Air Pollutants--Airborne contaminants which have not undergone any chemical reaction since being introduced into the environment.

Procurement--See "Acquisition."

Program Manager--Individual who is chartered with the responsibility for the successful execution of an approved program within specified boundaries of time, resources, and performance requirements.

Program Objective Memorandum (POM)--A biennial memorandum submitted to the Secretary of Defense (SECDEF) which recommends the total resource requirements and programs within the parameters of the SECDEF's fiscal guidance. The POM shows its programmed needs for two years hence, including manpower, force levels,

procurement, facilities, personnel issues, and research and development.

Recurring Costs--Expenses for personnel, material consumed in use, operating, overhead, support services, and other items incurred on an annual basis.

Recycled Material--Material that can be utilized in place of a raw or source material in manufacturing a product. (See 40 CFR 261.)

Secondary Air Pollutants--Airborne contaminants which have undergone one or more chemical reactions (with material naturally in the air or pollutants) since being introduced into the environment.

Specific Gravity--The weight of a solid or liquid substance, compared to the weight of an equal volume of water. The specific gravity of water is one (1.0).

Subchronic Exposure--Intermediate exposures between acute and chronic and may be for up to 90 days.

Supply Support--All management actions, procedures, and techniques used to determine requirements to acquire, catalog, receive, store, transfer, issue, and dispose of secondary items.

Support Acquisition Costs--Costs during development and procurement associated with the engineering and production logistics support deliverable items such as spare parts, data, support equipment, etc. These costs are documented in the Logistics Requirements and Funding Plan (LRFP).

Support Equipment--All equipment (mobile or fixed) required to support the operation and maintenance of a material system, including the acquisition of logistics support for the support and test equipment itself.

System--Combination of two or more interrelated equipments arranged in a functional package to perform an operational function or to satisfy a requirement, e.g., ship system, weapon system, fire control system, etc.

System Acquisition--Process by which weapon systems, weapon platforms, and related equipment are conceived, designed, obtained, and introduced into operational use.

Technical Data--Recorded information (regardless of the form or nature of recording) of a scientific or technical nature (including computer software documentation) relating to material procured by the Navy.

Teratogens and Mutagens--Two types of reproductive disorders often associated with an occupational hazard. Teratogens affect the fetus, so their toxic effect is indirect. Mutagens attack the chromosomes of the species instead of the individual.

Test and Evaluation Master Plan (TEMP)--Controlling management document which defines the test and evaluation for each acquisition program.

Toxicity--Ability of a chemical to cause injury once it reaches a susceptible site in or on the body.

Uniform Annual Cost--Defined in SECNAVINST 7000.14B as the amount of money which if budgeted in equal yearly installments would pay for a project. The total present value of these installments would be equal to the total present value computed from the estimated life cycle-costs.

User Logistics Support Summary (ULSS)--Summarizes and lists the support products and schedules pertaining to a specific equipment.

Vapor Density--Relative density of a vapor or gas compared to air. Air is rated as one (1.0). A figure of less than one indicates a vapor or gas is lighter than air. A figure greater than one indicates a vapor or gas is heavier than air.

Vapor Pressure--Pressure built up in the limited space above a liquid by escaping molecules (vapors) of the material. Vapor pressure is measured in pounds per square inch Gage (psig). Gage pressure does not include the normal atmospheric pressure of 14.7 pounds.

Water Solubility--Ability of a material to form a homogeneous solution with water. For example, salt is water soluble but oil is not.

APPENDIX B

LOGISTICS REVIEW GROUP (LRG)
AUDIT CHECKLIST

OPNAV P-45-112-91

LOGISTICS REVIEW GROUP (LRG) AUDIT CHECKLIST

FOR

HAZARDOUS MATERIAL CONTROL AND MANAGEMENT (HMC&M)

January 1992
Chief of Naval Operations

LOGISTICS REVIEW GROUP (LRG) AUDIT CHECKLIST
FOR
HAZARDOUS MATERIAL CONTROL & MANAGEMENT (HMC&M)

REFERENCES

(a) DoDD 4210.15
(b) DoDD 5000.1
(c) DoDI 5000.2
(d) OPNAVINST 4110.2
(e) OPNAVINST 5000.49A
(f) MIL-STD-1388-1A
(g) MIL-STD-882B

PURPOSE

This checklist is to be used in LRG audits of Acquisition Categories (ACAT) I and II and to serve, suitably adapted by Echelon 2 Commands, in their milestone audits for systems in ACAT III and IV. ACAT I and II are systems of such size and complexity that only one program is assigned per Program Manager. ACAT III and IV system programs are generally managed by a designated Systems Command (SYSCOM) (e.g., NAVAIRSYSCOM, NAVSEASYSCOM, SPAWARSYSCOM) and are of lesser magnitude. This checklist may be, at the option of the Program Manager, incorporated into the applicable relevant existing checklists; or used in a separate and distinct audit for certification into the next phase - milestone.

BACKGROUND AND REQUIREMENTS

References (a) - (g) contain explicit requirements regarding inclusion of HMC&M throughout the system life cycle. Audit team members should familiarize themselves with the HMC&M provisions in the references. This is necessary for a full understanding of the background and requirements underlying the audit checklist questions.

SUGGESTED AUDITOR QUALIFICATIONS

In addition to demonstrated knowledge and understanding of the relevant components of references (a) - (g), the user of the checklist should have specific knowledge and training in HMC&M principles, and their application in the system acquisition process. Pending availability of such personnel within the program office or to Program Managers and LRG Audit Teams, personnel with relevant engineering and scientific backgrounds may be requested from such sources as SYSCOMs.

SCOPE OF CHECKLIST

It is virtually impossible to address in a generic sense the details of all potential HMC&M concerns associated with Integrated Logistics Support (ILS) and resulting LRG audit of a specific system. For example, there are currently over 40,000 material safety data sheets in the Hazardous Material Information System (HMIS) system. Any one system and its supporting subsystems and equipment may involve hundreds of different materials or hazards.

As a result, this checklist is for management type audits and appraisals. It is designed to ensure that adequate consideration is being given to associated HMC&M requirements, rather than being an inspection type or a detailed functional investigation. The objective is to ensure that the systems manager is taking appropriate management action to control hazardous material; reduce hazardous waste and associated risks to an acceptable level; and where these materials must be used, ensure that appropriate protective action is provided for the operational user.

LRG AUDIT CHECKLIST FOR HAZARDOUS MATERIAL CONTROL & MANAGEMENT

Weapon System	Phase 0/Milestone I	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
1. Ascertain if the Development Options Paper (DOP) and Operational Requirement (OR) or equivalent operational requirement specification documents contain the requirements to identify, minimize, control and/or dispose of potential environmental hazards, hazardous material (HM) and hazardous waste (HW) (para D, DoDD 4210.15; Part 6, Section I, DoDI 5000.2; para 6.a., OPNAVINST 4110.2). 2. Ensure that occupational health and environmental hazard/toxicological research requirements have been identified for any new material or for existing HM with new and previously not used purpose, and funding requirements for R&D are planned so that the results are acquired and provided at the appropriate phase points and milestones (para 6.a.(2), OPNAVINST 4110.2). 3. Has HMC&M been addressed in a Preliminary Hazards Analysis (PHA) per OPNAVINST 5100.24A? Are recommendations being implemented (para 6.b.(1) and 7.c.(5), OPNAVINST 5100.24A; para 9.d., OPNAVINST 4110.2)? 4. Ensure that requirements to identify HM and implement HMC&M requirements are being included in contracts (Part 6, Section I, DoDI 5000.2; para 6.a., OPNAVINST 4110.2). 5. Ensure that HMC&M requirements for contractor compliance are included in source selection evaluation criteria (Part 6, Section I, DoDI 5000.2; para 6.a., OPNAVINST 4110.2).			

LRG AUDIT CHECKLIST FOR HAZARDOUS MATERIAL CONTROL & MANAGEMENT

Weapon System	Phase 0/Milestone I	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
6. When it is known that HM, that constitutes environmental, safety, and occupational health problems, have to be incorporated into the system without alternative, determine if the associated Integrated Logistics Support Plan (ILSP) element has been considered and incorporated in the plans for Milestone I (para 7.5.1, 7.8.2, 7.9.1, and 7.9.2, of Table 1.2, Enclosure (1), OPNAVINST 5000.49A (replace with appropriate para of SECNAVINST 5000.XX, "Integrated Logistics Support (ILS) in the Acquisition Process," when issued)). 7. Ensure that planning for use of HM or substitution of less HM will be supported by life cycle cost estimates appropriate to the magnitude of the decision being made (para 6.f., OPNAVINST 4110.2). 8. Does the Logistics Requirements and Funding Plan (LRFP) include HMC&M requirements. These funding requirements may be separated or integrated across several ILSP elements (para 8.g.(7), OPNAVINST 4110.2). 9. Examine Statement of Work (SOW) requirements for contractors and subcontractors to identify adequacy of provisions for meeting Navy objectives for HMC&M and reduction of environmental, safety, and occupational health impacts (para 6.a.(1) and (2), OPNAVINST 4110.2 (add appropriate para of SECNAVINST 5000.XX when issued)).			

LRG AUDIT CHECKLIST FOR HAZARDOUS MATERIAL CONTROL & MANAGEMENT

Weapon System	Phase I/Milestone II	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
1. Ascertain if a plan and schedule for implementation of HMC&M were submitted to OP-04. Review the Plan and identify specific actions to be included in this audit (para 9.b., OPNAVINST 4110.2). 2. Determine if the following have been accomplished for environmental, safety, and occupational health attributes and included in appropriate documentation: a. Hazard analysis, risk assessment, and life cycle cost estimates of HM/HW associated with recommended system alternatives, with adequate detail to support the final decision (Part 6, Section I, DoDI 5000.2; para 9.d. and 6.f., OPNAVINST 4110.2). b. Procedures to ensure identification of HM and justification of management decisions to accept risk of using HM (Part 6, Section I, DoDI 5000.2). 3. Identify the HM, HW, and environmental pollutants that should be considered for substitution with less hazardous ones; or if HM must be used, ensure appropriate safeguards are programmed and included in the design development. Both peacetime and wartime functions are to be considered (Part 6, Section I, DoDI 5000.2; para 6.a.(1) and (2), 8.g.(3), and 9.d., OPNAVINST 4110.2). 4. Determine if design alternatives to correct HMC&M deficiencies, identified in 3 above, have been examined and are included in the decision process (Part 6, Section I, DoDI 5000.2; para 7.c.(5)(h), OPNAVINST 5100.24A).			

Weapon System	Phase I/Milestone II	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
5. Review the facilities support plans for adequate inclusion of design requirements/facility requirements for storage of HM, HW, control of environmental pollution (air, water, solid and toxic waste) and compliance with Federal, state, and local codes, standards, and regulations. These plans include, but are not restricted to, depots, government owned/contractor operated (GOCO) facilities, operating shore activities of the U.S. Navy, and fleet ships, submarines, aircraft, small craft or affected weapon platform. In the case of operating forces (e.g. ship class or aircraft type), this review will obtain concurrence of either the acquisition/life cycle manager or the Hardware Systems Command (HSC) project officer exercising engineering responsibility (Part 6, Section I, DoDI 5000.2; para 6.b., OPNAVINST 4110.2; para 7.c.(5)(f), OPNAVINST 5100.24A). 6. Ensure that procedures are being developed for safe and environmentally acceptable use, storage, and disposal of HM and generated HW. Ensure that required procedures are integrated into affected logistics planning documentation, including at a minimum the ILSP, maintenance planning, supply support, packaging, handling, storage and transportation (PHS&T), technical manuals and periodic maintenance (PMS) documentation (Part 6, Section I, DoDI 5000.2; para 7.c.(5)(f) and (i), OPNAVINST 5100.24A (add appropriate para of SECNAVINST 5000.XX when issued)). 7. Ensure that research and development (R&D) studies have been initiated to define environmental, safety, and occupational health requirements on any new HM or new HM application that has to be used in the system design. For example, examine DD Form 1498, "Research and Technology Work Unit Summary" (para 6.a.(2), OPNAVINST 4110.2).			

LRG AUDIT CHECKLIST FOR HAZARDOUS MATERIAL CONTROL & MANAGEMENT

Weapon System	Phase I/Milestone II	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
8. Does the LRFP include HMC&M requirements. These funding requirements may be separate or integrated across several ILSP elements (para 8.g.(7), OPNAVINST 4110.2). 9. Does the LRFP include HMC&M requirements for major claimants other than that of the Program Manager? Specifically, have affected fleet commanders, operating shore activities, supply system activities, and other commands affected by HM introduction been notified and provided budgetary information essential for execution of their respective HMC&M responsibilities (para 8.g.(7), OPNAVINST 4110.2). 10. Review the SOWs and specifications to ensure that they contain a contractual requirement for the contractor to include HM warnings and precautions and HMC&M requirements in all technical documentation (para 8.c.(6), OPNAVINST 4110.2 (add appropriate para of SECNAVINST 5000.XX when issued)). 11. Determine if the Program Manager has prepared a HM Authorized Use List (AUL) and applicable references within the program documentation or if one is being developed for the system and its equipment (para 8.g.(1),(2), and (4), OPNAVINST 4110.2).			

LRG AUDIT CHECKLIST FOR HAZARDOUS MATERIAL CONTROL & MANAGEMENT

Weapon System	Phase II/Milestone III	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
1. Determine if HMC&M plans and schedules have been submitted to OP-04 by the Program Manager. If so, have they been reviewed and approved? Review the plans and identify specific items to be followed up in the course of this audit, such as (para 9.b., OPNAVINST 4110.2): • Identification of HM/HW reduction plans for the system, and contractors' documented justification that a suitable substitute of lesser environmental, safety, and occupational health impacts cannot be used and still meet system requirements (Part 6, Section I, DoDI 5000.2). • Inclusion of HMC&M and HM controls and precautions in system documentation (Part 6, Section I, DoDI 5000.2). 2. Determine if HMC&M requirements for reduction in use of HM have been considered and supported by life cycle cost estimates, including the cost of acquiring, handling, using, and disposing of HM (para D, DoDD 4210.15 and para 6.f. and 9.d., OPNAVINST 4110.2). 3. Ascertain the status of any HMC&M R&D called for in earlier phases. Determine if the results have been provided in a timely fashion and have been considered in decisions regarding compliance with HMC&M requirements (para 6.a.(2), OPNAVINST 4110.2).			

Weapon System	Phase II/Milestone III	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
4. Obtain documentation from hazard analyses, risk assessments, and life cycle cost estimates and ascertain the adequacy of results for system HM and ensure that the results are incorporated into the decision process for the system (para 6.f. and 9.d., OPNAVINST 4110.2). 5. Review the plan for HMC&M requirements with the Program Manager to ensure that it is properly integrated into the ILSP and Logistic Support Analyses (LSA) with special reference to (para 8.g. and 9.b., OPNAVINST 4110.2): • Plans and implementation of overview of contractor/subcontractor compliance with SOW requirements (para 6.a., OPNAVINST 4110.2 (add appropriate para of SECNAVINST 5000.XX when issued)). • Actions to establish procedures to identify and correct HM hazards and select least HM (Part 6, Section I, DoDI 5000.2). • "Closed Loop" feedback review and approval processes to ensure HMC&M deficiencies are recognized and corrected or risks accepted on the basis of formal documentation (para 7.c.(b)(2), OPNAVINST 5100.24A). • Establishing and maintaining programs to assist in reducing/minimizing entry of HM into the supply system which will control quantities to ensure minimal HW generation (para 8.g.(3), OPNAVINST 4110.2).			

Weapon System	Phase II/Milestone III	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
• Providing input to NAVSUP on any HM to be added to Navy AUL (para 8.g.(1), OPNAVINST 4110.2). • Obtaining concurrence of affected ship class or aircraft type acquisition/life cycle manager that adequate HM/HW storage and processing capability is either present or planned and funded (para 8.g.(3), OPNAVINST 4110.2). 6. Examine SOW requirements for contractors and subcontractors to identify adequacy of provisions for meeting Navy objectives for HMC&M and reduction of environmental, safety, and occupational health impacts (para 6.a.(1) and (2), OPNAVINST 4110.2 (add appropriate para of SECNAVINST 5000.XX when issued)). 7. Verify that there are explicit provisions for adequate resources for HMC&M requirements in the LRFP and the User Logistics Support Summary (ULSS). These funding requirements may be separate or integrated across several ILSP elements (para 8.g.(7), OPNAVINST 4110.2 (add appropriate paragraph of SECNAVINST 5000.XX when issued)). 8. Does the LRFP include HMC&M requirements for major claimants other than that of the Program Manager? Specifically, have affected fleet commanders, operating shore activities, supply system activities, and other commands affected by HM introduction been notified and provided budgetary information essential for execution of their respective HMC&M responsibilities (para 8.g.(7), OPNAVINST 4110.2).			

Weapon System	Phase II/Milestone III	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
9. Ensure that procedures are being developed for safe and environmentally acceptable use, storage, and disposal of HM and generated HW. Ensure required procedures are integrated into affected logistics planning documentation, including at a minimum the ILSP, maintenance planning, supply support, PHS&T, technical manuals and PMS documentation (Part 6, Section I, DoDI 5000.2; para 7.c.(5)(f) and (i), OPNAVINST 5100.24A (add appropriate para of SECNAVINST 5000.XX when issued). 10. Review the SOWs and specifications to ensure that they contain a contractual requirement for the contractor to include HM warnings and precautions and HMC&M requirements in all technical documentation (para 6.a.(1) and (2), OPNAVINST 4110.2 (add appropriate para of SECNAVINST 5000.XX when issued)). 11. Determine if the Program Manager has prepared a HM AUL and applicable references within the program documentation or if one is being developed for the system and its equipment (para 8.g.(1),(2), and (4), OPNAVINST 4110.2). 12. Review the HMC&M plan and schedules and ILSP and determine specific HMC&M actions required to be completed by Milestone III. Ensure that these items are completed (para 8.g.(8) and 9.b., OPNAVINST 4110.2). 13. Determine if HMC&M requirements called for in the SOWs or other contractual arrangements are being complied with by the contractor, and that review is being accomplished by the Program Manager to ascertain adequacy (Part 6, Section I, DoDI 5000.2; para 6.a.(1) and (2), OPNAVINST 4110.2).			

Weapon System	Phase II/Milestone III	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
14. Review and ensure that by the time of initial deployment, all technical documentation (such as technical manuals, PHS&T planning data, facilities planning data, training course material, maintenance plans, phased support plan(s), etc.) includes warnings, precautions, and HMC&M compliance requirements. Specifics should be included regarding any authorized HM, disposal of HW, training, environmental controls, safety precautions, and personal protective equipment. If technical documents are not available, review the SOWs and specifications to ensure that they contain a contractual requirement for the contractor to include HM warnings and precautions and HMC&M requirements in all technical documentation (para 8.c.(6), OPNAVINST 4110.2). 15. Ascertain if review has been accomplished by appropriate Navy organizations regarding HMC&M with sufficient lead time for any needed action by time of initial deployment (e.g., completion of occupational safety and health (OSH) training and material safety data sheet (MSDS) requests, Resource Conservation and Recovery Act (RCRA) permits, and other environmental permits) (Part 6, Section I, DoDI 5000.2; para 5-5, OPNAVINST 5090.1). 16. Determine the status of action by the Program Executive Officer (PEO), HSC, HMC&M Coordination Office and NAVSUPSYSCOM to add any system HM AUL to the Navy HM AUL. Note: If the system is to have shipboard use, ensure that similar appropriate action is being taken with regard to the Ships Hazardous Material List (SHML) (para 8.g.(1),(2), and (4), OPNAVINST 4110.2).			

Weapon System	Phase II/Milestone III	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
17. If the SOW called for MIL-STD-882B, Task 205, Operating and Support Hazards Analysis, review the report and determine if recommendations have been approved and applied or, if not, note if adequate justifications exist and are documented (Part 6, Section I, DoDI 5000.2).			

LRG AUDIT CHECKLIST FOR HAZARDOUS MATERIAL CONTROL & MANAGEMENT

Weapon System	Phase III & IV/Milestone IV	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
1. Review the HMC&M plan and schedules and ILSP and determine specific HMC&M actions that are required to be completed by initial deployment. Ensure that these actions are completed (para 8.g.(8) and 9.b., OPNAVINST 4110.2). 2. Verify that HMC&M requirements are included in final technical manuals, supply support documents, PHS&T documents, planned and corrective maintenance procedures, training materials, drawings and specifications (para 6.c.(6), OPNAVINST 4110.2). 3. Determine if engineering changes involving HMC&M have been properly reviewed and approved by competent staff and that funding requirements have been identified for possible future changes arising from initial deployment operations (para 8.g.(7) OPNAVINST 4110.2 and para 7.c.(5)(m), OPNAVINST 5100.24A). 4. Verify that any HM authorized is on the Navy AUL and forces afloat SHML (para 8.g.(1), OPNAVINST 4110.2). 5. Conduct on-site observations on status of military and civilian training regarding HMC&M including environmental/RCRA HW training and Occupational Safety and Health Administration (OSHA) hazard communication and HW training (para 8.g.(6), OPNAVINST 4110.2).			

Weapon System	Phase III & IV/Milestone IV	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
6. Conduct on-site observations at initial deployment on availability of technical materials (such as technical manuals and publications, supply support documents, PHS&T documents, training materials, etc.) at all echelons including operations, organizational maintenance, depot maintenance, and contractor support (para 4.n., enclosure (5), OPNAVINST 5000.49A (replace with appropriate para of SECNAVINST 5000.XX when issued)). 7. Conduct on-site evaluations of availability and adequacy of engineering controls, spill control plan, personal protective equipment, environmental (air, water, solid waste) control and disposal and for HM and HW storage and disposal facilities, including the status of any required permits (para 6.b., OPNAVINST 4110.2). 8. Determine if plans and instructions for disposal of HW and disposal of the system itself have been formulated: (Part 6, Section I, DoDI 5000.2; para 6.c.(6) OPNAVINST 4110.2 and para 7.c.(5)(f), OPNAVINST 5100.24A). • If not, ascertain the schedule for preparation and provisions for including full compliance with all HM requirements and environmental, safety, and occupational health codes, standards, and regulations, including permits (para 6.b., OPNAVINST 4110.2). • If so, obtain and review for adequacy, with special attention to provisions on HM use during demilitarization, including compliance with all codes, standards, regulations, and permit requirements (para 6.c., OPNAVINST 4110.2).			

Weapon System	Phase III & IV/Milestone IV	Auditor(s)	Date:	Page

LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
9. Review all HMC&M program plans and documents to ensure that they have been updated to reflect any new requirements associated with initial deployment of the system. Determine if there are procedures in place to allow feedback or lessons learned from deficiencies identified during initial deployment to be used to update post production ILS plans. The areas which should be evaluated include, among others: (Part 6, Section I, DoDI 5000.2; para 8.g., OPNAVINST 4110.2). • Deficiencies in technical data. • Need for change to less HM from those specified in the system. • Deficiencies in training materials on HMC&M. • Deficiencies in personal protective equipment and emergency response equipment. • Inadequacies of performance of specified HM. • Inadequate or excessive allowances of HM resulting in either delays in system operational capability or in excess of unneeded HM. • Problems associated with improper disposal of HW and excess HM. • Deficient designs in control measures and preventive procedures.			

Weapon System	Phase III & IV/Milestone IV	Auditor(s)	Date:	Page

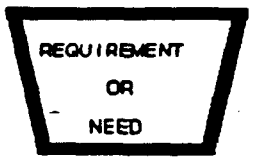
LRG AUDIT CHECKLIST ITEMS *(S = SAT, X = UNSAT)	SAT*	N/A	AUDITOR COMMENTS
• Accident/incident investigative reports involving HM and environmental impacts. 10. If post production maintenance support for the system is to be by contractor in whole or in part, determine if the SOW/contract requirements include full consideration for HMC&M areas. This should include requirements that the contractor select least HM, prepare precautionary and disposal requirements for any required HM, and request changes in specifications associated with changes to less HM (Part 6, Section I, DoDI 5000.2; para 6.a., OPNAVINST 4110.2 (add appropriate para of SECNAVINST 5000.XX when issued)). 11. Verify that a permanent record of identified hazards and close out actions exists, and is current (Part 6, Section I, DoDI 5000.2; para 7.c.(5)(o), OPNAVINST 5100.24A). 12. Ensure that all identified initial HM hazards are eliminated or adequately controlled (Part 6, Section I, DoDI 5000.2; para 8.g.(3) and (5), OPNAVINST 4110.2). 13. Determine if the Program Manager has prepared a HM AUL and applicable references within the program documentation or if one is being developed for the system and its equipment (para 8.g.(1),(2), and (4), OPNAVINST 4110.2).			

APPENDIX C

DESCRIPTION OF THE SUBSTITUTION CHART ELEMENTS*

* BASED ON THE "COORDINATED NAVY HAZARDOUS MATERIAL SUBSTITUTION MANUAL"

DESCRIPTION OF THE SUBSTITUTION PROCESS CHART ELEMENTS



C.1 Requirements or Need. This is the starting point for the Hazardous Material Substitution Process. The need for Navy substitution action arises from both generic and specific requirements. (See Figures C-1, C-2, and C-3 at the end of this Appendix).

C.1.1 Generic Requirements. Chapter 7 of the "Coordinated Navy Hazardous Material Substitution Manual" describes a priority system for generic action. The overall HM substitution policies and actions called for in DoD and Navy directives include:

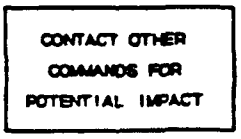
a. DoDD 4210.15 requires the use of the least hazardous materials, consistent with cost and missions requirements.

b. DoDI 5000.2 (Part 6, Section I) requires selection and use of the least hazardous materials. This document also requires special approval when military requirements call for use of high or serious risk materials.

c. The Navy priority scheme to adopt the EPA Industrial Toxics Projects (ITP) 17/33-50 groups of chemicals and the 10 to 20 items identified as the major HM "bad actors" provide candidates for substitution actions.

C.1.2 Specific Federal, State, and Local Regulations. Chapter 2 of the Manual cited above, discusses the impact of pending and actual Federal, state, and local regulations as generating a need for substitution actions. In many instances, the costs and other resource requirements of permits, recordkeeping, control measures, training, and potential liability can be avoided or minimized by taking timely substitution or process change measures.

C.1.3 Local Needs. Another major source of requirements or needs for substitution are locally generated actions which would require substitutions to be identified for either non-stock listed items or Federal stock listed items. For example, (consistent with OPNAVINST 4110.2.), a shipyard may need to compare the hazards and costs associated with the use of an alternative for glues used in the carpentry and wood shop. The substitution process chart would be utilized in order to explore substitution possibilities instead of using the hazardous materials and disposing any resultant waste as HW. Another source of "needs" is the identification by user personnel of possible substitutes based on local knowledge.



C.2 Contact Other Commands for Potential Impact. This block is one of the most important initial actions within the substitution process chart. (Note however, that this block is not shown as a "process delay point.") To ensure that problems do not occur between Commands, the Command sponsoring or identifying the substitution requirement and need should contact all other Commands concerning the requirement or need. The Command establishing the "need" or requirement should contact all Echelon 2 Commands and cognizant In-Service Engineering Activities (e.g., the Ships Engineering Support Office (SESO), Aviation Supply Office (ASO), Naval Air Warfare Support Center, etc.). N45 should be contacted for information as to specific points of contact within the Navy and in other DoD components which may have similar problems.

Potential impact problems, without such coordination, might be:

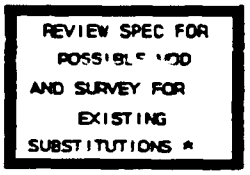
a. Deletion of a material used in other Echelon 2 Commands, for which a unique or special requirement exists.

b. Substitution of a new material which meets one Command's needs and engineering requirements, but which is incompatible with materials authorized for another Command.

c. Research and development or engineering development on a similar problem are already underway in another organization.

C.3 Operational Impact. This question addresses whether the basic material has a valid operational need. As an example, in the review of various specifications, a hazardous material might be identified that is no longer used in the Navy. As a result, the answer is "no," and further actions are to be taken to delete the requirement for that specification. The logical question associated with this decision block would be: "Is this material still in use?" Another question could be "Is it in use but other substitutes are already available and approved and its withdrawal would have no operational impact?" The answer would also be "no" with same follow on action. If the answer to the latter question were "yes" as for approved substitute materials in use, then the need would exist to determine their suitability as a substitute material. The "yes" answer to an operational impact question leads to the need for studies to find substitutes for materials and/or processes.

C.4 Need for Substitute Materials and Processes. The next step in the process is the generation of a "Needs Statement." It should clearly state the objective of the substitution action, provide a clear plan of the actions required, and identify milestones for the various elements of the process. Such a "statement" should indicate the organizations responsible to accomplish the necessary actions. Funding requirements should be identified. If there is an assigned Navy "lead organization" for the material for which substitution is needed (e.g., NAVSEA for the Ozone Depleting Chemicals Program), the Needs Statement serves as a vehicle to establish the using Command's requirements with the lead organization. The Needs statement also includes identification by the originator of possible relationship of process changes to substitution. The possibility of a dual-track approach should be considered.



C.5 Review Specifications. The next step in the process is to determine if the existing specification allows alternative material composition. The vast majority of Federal and Military Specifications are performance based. A number of National Stock Number (NSN) items meeting the specification may (and many do) have different compositions. In some instances, one of these may be a suitable candidate for substitution. In a number of cases, action may already been taken to provide an alternate specification to meet environmental regulations. For example, GSA has published a list of low VOC paints and solvents which may or may not meet the follow-on steps of the substitution process.

C.6 Possible Substitutions Exist. Based on the results of the previous step, some existing NSN materials may be identified as possible candidates for substitution action. In addition, a wide variety of sources of possible candidates should be considered. These include advertisement for "environmentally acceptable" materials, contact with manufacturers, review of "Chemical Abstracts," and use of Command engineering resources. The previously stated need for contact with other Echelon 2 Commands, plus contact with other military services, GSA, and DLA may identify potential candidates.

C.6.1 The substitution algorithm is a methodology using a step-by-step procedure comparing two or more HM. The results shall be used for entry into any decision analysis box of the Substitution Process Chart. The algorithm provides a means for identifying "high" or "serious" risks requiring special approval per DoDI 5000.2. The algorithm assigns numerical "points" for such elements as toxicity, medical effects, duration of expected exposure, fire and explosion potential, etc.

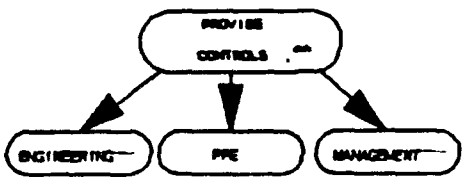
C.6.2 There may be candidates for replacement of an existing Navy Authorized Use List (AUL) item, a proposed replacement for an existing Department of Defense (DoD) Federal specification material, or in the selection of the least hazardous of two or more candidates for use in a new system. The algorithm methodology is not the sole determining consideration. It is intended for use as a screening device for ranking existing and/or proposed materials by their properties affecting health, environment, and safety. The points are totaled and used for comparison of one material's "Hazardous Material Selection Factor" (HMSF) with another.

C.6.3 If no possible substitutions exist, the next step is the R&D box. If the answer is yes, then the next major block is identifying additional applications. As discussed in paragraph C.2 above, if possible substitutions have been identified then other Echelon 2 Commands need to be contacted to see if the proposed best substitute may have other potential uses than those which the substitute is being examined or tested. Such contact also needs to identify if bringing this substitute into the system is going to create any new problems with the other Commands. This contact should also seek information as to whether the other Commands have potential substitutes which also might be considered.

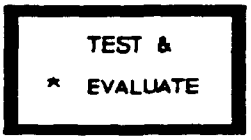
C.7 Initiate Substitution R&D. If possible substitutions are not found to exist, it becomes necessary to initiate a Research and Development (R&D) program to identify new potential material candidates. The R&D effort may be two-fold; it may be for an actual material development or R&D or it may be for new applications of an engineering development nature. It also may involve research on improved processes and procedures. In the case of new systems, the R&D process must be initiated so that results and decisions for new materials which have never been used before (such as synthetic carbon materials) are in phase with system acquisition milestones. Before initiation of R&D projects, contact other commands as in C.1 above.

R&D is a lengthy and costly process; therefore, the initiation of the R&D requirements must include necessary funding options to accomplish the R&D.

C.8 New Substitute Found. If the R&D effort results in new candidates for substitution, then the substitution process proceeds to the "test and evaluation" block. If no candidates are found, then the process proceeds to the "provide controls" block.

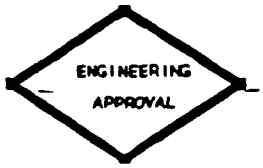


C.9 Provide Controls. If R&D does not identify new candidates, then the block to "provide controls" becomes a very important block. As indicated with a double asterisk, it becomes necessary to obtain engineering approval for the non-stock number items. Furthermore, the existing material, such as a VOC material for which there is no substitute, may require extensive engineering for environmental compliance controls beyond those already in use; and/or may require additional personal protective equipment to meet OSHA requirements. Continued use of the material also may require additional management considerations such as application for permits or changes for operating procedures, to meet new regulatory requirements. Considerations include those associated with the Federal Facilities Compliance Act of 1992, Clean Air Act Amendments of 1990, and other similar changes.



C.10 Test and Evaluation. Determination of suitability of the candidate material to satisfy Navy needed or intended use is a major element of the substitution process. There are two major aspects which are included in the Test and Evaluation (T&E) plan: are engineering evaluation and assessment of life cycle costs. T&E includes both laboratory testing and field engineering studies. It may be a lengthy process and also may require resources for which funding should be anticipated in the "Needs" statement.

Note: The substitution process recognizes that the nature of Navy operational and maintenance functions is such that in some instances the least hazardous material identified by use of the algorithm will not meet such needs.



C.11 Engineering Evaluation. The engineering evaluation is in effect a feasibility study using the results of the "test and evaluation" block. Among the issues to be addressed are:

a. Does the material meet required performance standards, as well or better than use of the existing material?

b. Is its durability/mean time to failure satisfactory from a mission and operational suitability viewpoint?

c. Does it create a new hazard (e.g., such as substituting a lower toxicity material that has a fire hazard, for a higher toxic one without such hazard)?

d. Will the new material's use adversely affect scheduled maintenance or operational cycles?

e. Does it create a requirement for major process or equipment changes?

f. Is it compatible with the working surface/equipment used on or with the material?

Note: In the event the Engineering Evaluation results in a finding that the proposed substitute is not satisfactory, the next element is "Another Substitute Available?" Generally there would be two more possible substitute candidates. In that event, the Test and Evaluation process would be reinitiated for the next most desirable substitute. If all possible substitutes fail the engineering evaluation, or there is none, then Research and Development is initiated again or approval for continued use of the existing material is requested of the appropriate decision authority. In the event of approval, then any required controls to meet current codes, standards and regulatory requirements must be provided.

LIFE CYCLE COST ANALYSIS

C.12 Life Cycle Cost. A Life Cycle Cost (LCC) estimate is required for both the currently used HM and the proposed substitute or for the two most likely candidates where no existing material is being considered. The LCC estimate should be commensurate with the scope of the hazard and intended use of the HM.

C.12.1 At a shore activity considering a substitute for a local use material (such as paint) the LCC estimate begins with initiation of procurement, its receipt, storage, issue, use, and disposal. Among the costs that should be included are any work place monitoring, training, personal protective equipment, work place controls, and disposal.

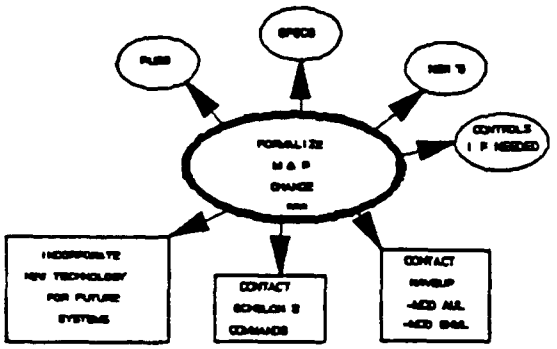
C.12.2 In the case of HM associated with a new or modified weapon system (e.g., an auxiliary propellant for a subsystem), such considerations as the cost of obtaining the material, transportation, installing the specialized equipment, testing and monitoring, spill clean-up, etc., have to be accounted for and documented. Also the costs associated with the depot maintenance of the weapon system due to the presence of the material have to be included in the estimate. The LCC estimate determination must cover all HM related costs for each Weapon System Acquisition phase, from Milestone 0 to ultimate disposal of the systems.

C.12.3 If the LCC estimate does show an increase in the cost of a proposed substitute over the in use or base material or the proposed substitute over the next likely candidate, the matter will have to be referred to the appropriate decision authority. Even if there is no life cycle cost increase, if the proposed substitute is a "serious" or "high risk," approval will also have to be obtained. If the best item is more costly but still does the job as well and appears to be the most useful from the Navy's viewpoint, it will have to be referred to a higher authority through the SYSCOM to DCNO Logistics for approval. (There is a major need for "decision authority approval" if the best material is also more costly.)

C.13 Decision Authority Approval. The "Decision Authority Approval" for less than "high" or "serious" risk HM will vary from Command to Command. It should be designated in any Echelon 2 implementing instructions. For "high" and "serious" risk materials, even if less hazardous than existing items, the requirements of DoDI 5000.2, Part 6, Section I, are to be met. Approvals for use of "high" and/or "serious" risk hazards must be obtained as described in paragraph C.2. (Depending upon the organization and delegation of the command, the "decision authority approval" may be "engineering approval.")

C.13.1 Resource Requirements-POM Action. In the majority of cases, substitution actions generate additional resource requirements. Because of the lead time to obtain approval in the Navy's budget, any such needs should be identified as soon as possible and action taken for inclusion in "Program Objective Memorandum" (POM). Such needs are those identified in the "Formalize M&P Changes" block.

C.13.2 Documentation. Chapter 8 of the Manual provides guidance for documenting requests for approval.



C.14 Formalize Material and Process Change. The end of the substitution process involves a wide variety of implementing actions.

C.14.1 Coordination with NAVSUP is essential to ensure the necessary planning and actions to phase out procurement of the current material and phase in procurement of the newly authorized one. Such planning and action are also needed to update the SHML and/or AUL for inclusion of new National Stock Numbers (NSN).

C.14.2 Changes to all maintenance and other documents specifying the use of the current material have to be made. Otherwise, since such are the "controlling documents," continued procurement and use by using organizations will occur.

C.14.3 A substitute material may, and many will, still require controls to comply with environment, safety, and health requirements. These must be identified, planned for, and be in place concurrent with the availability and use of the new material. Any new training requirements must be identified and accomplished in advance of issue of the new item.

FIGURE C - 1
HM SUBSTITUTION PROCESS

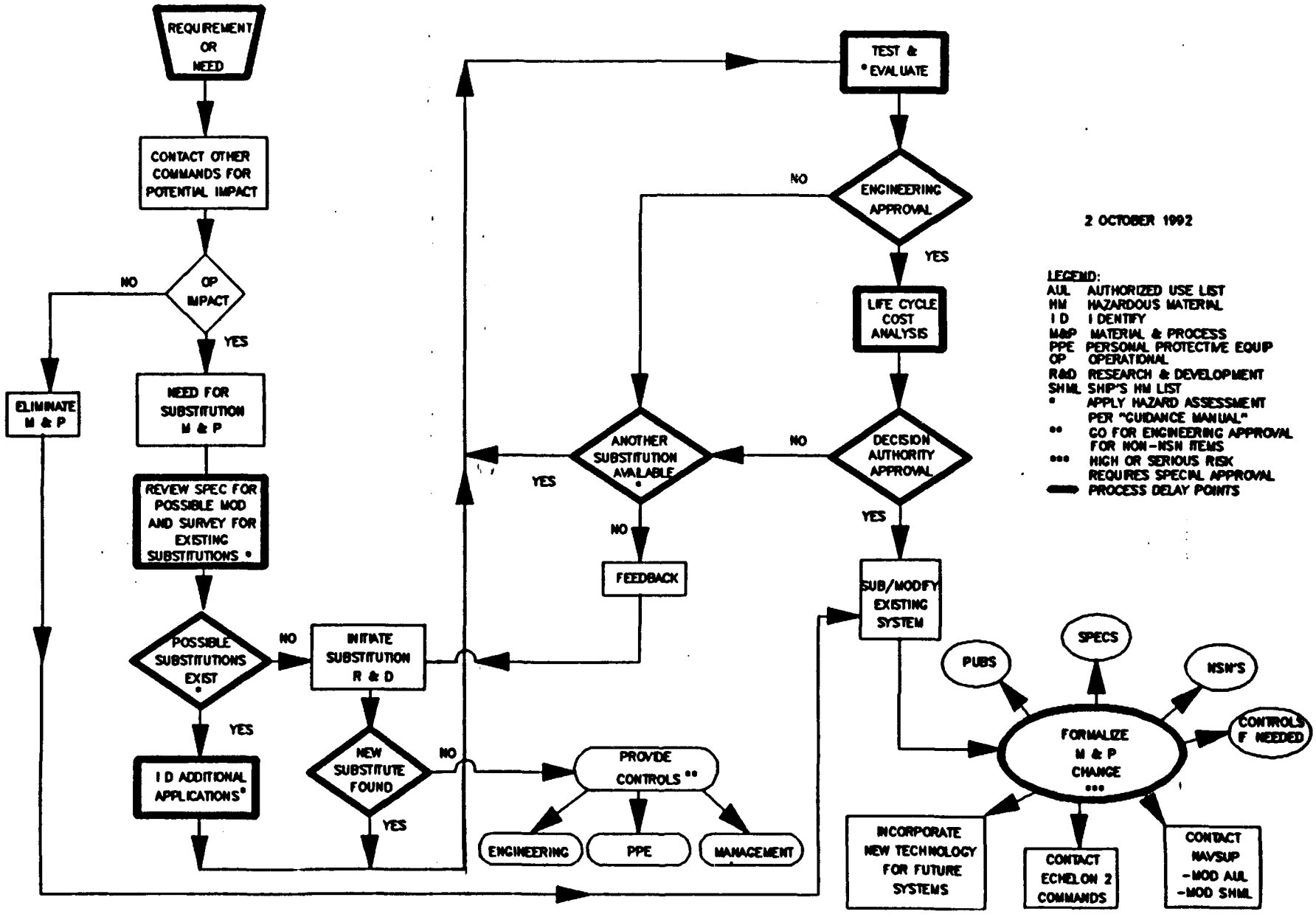


FIGURE C - 2

HM SUBSTITUTION PROCESS

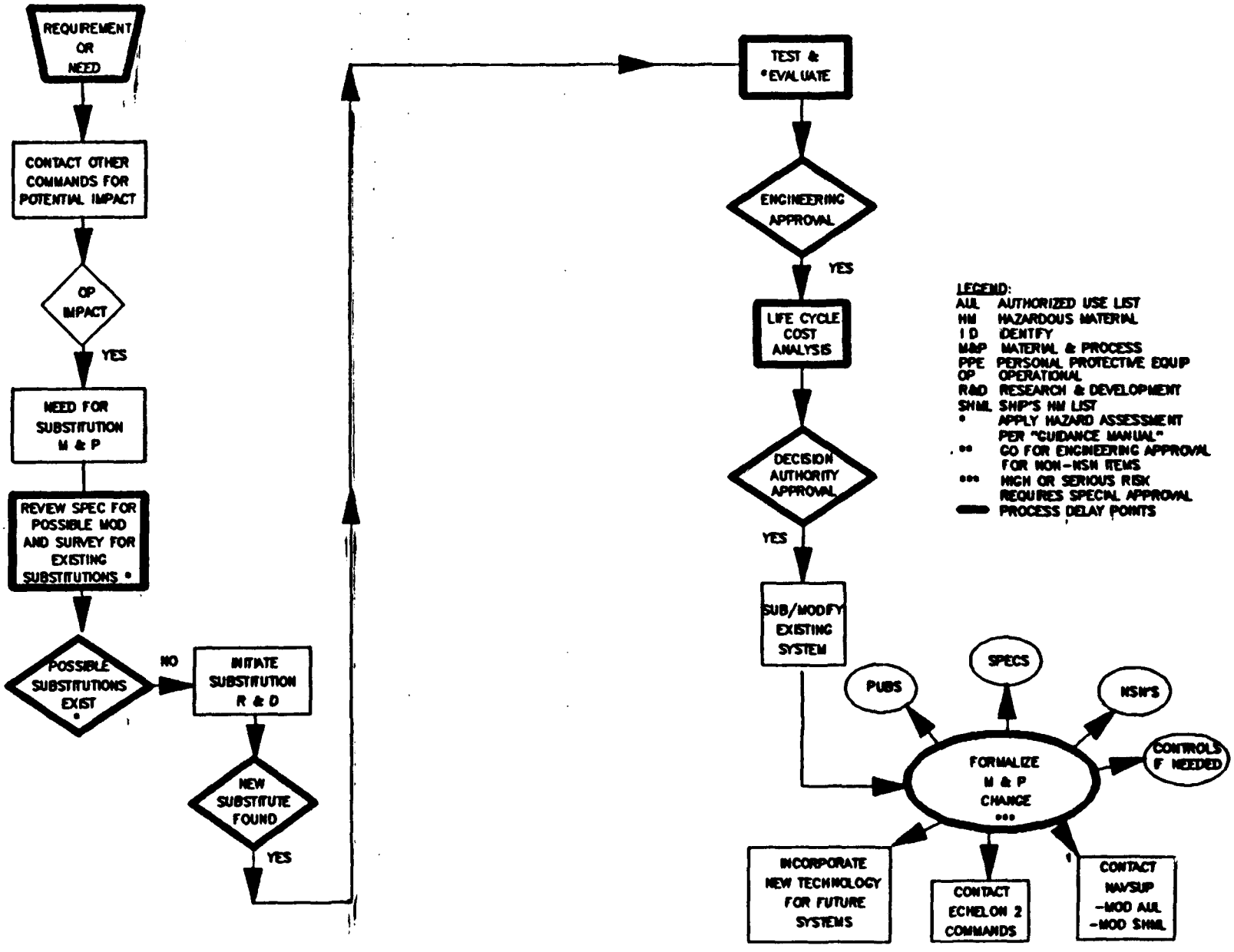
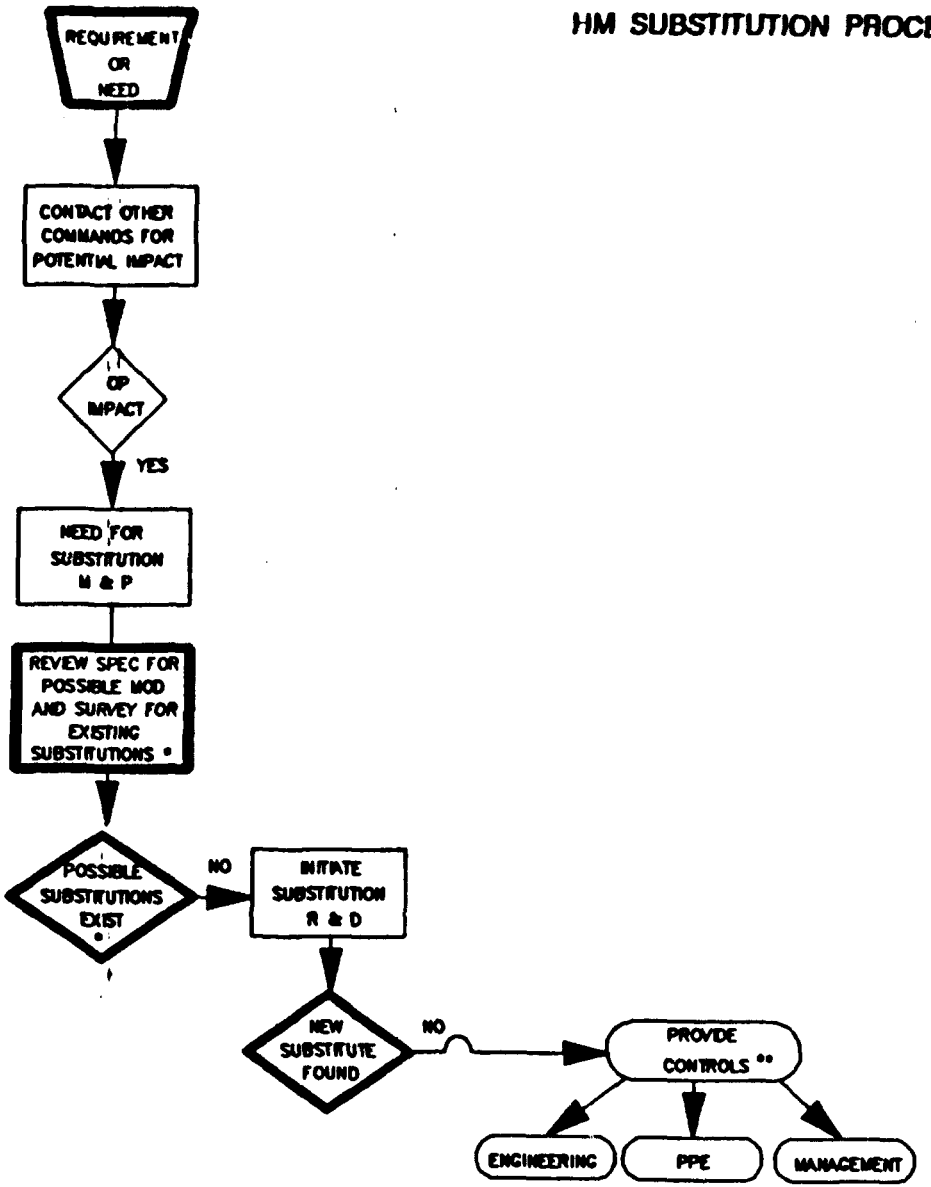


FIGURE C - 3

HM SUBSTITUTION PROCESS



LEGEND:

AUL	AUTHORIZED USE LIST
HM	HAZARDOUS MATERIAL
I D	IDENTIFY
M&P	MATERIAL & PROCESS
PPE	PERSONAL PROTECTIVE EQUIP
OP	OPERATIONAL
R&D	RESEARCH & DEVELOPMENT
SHML	SHIP'S HM LIST
*	APPLY HAZARD ASSESSMENT PER "GUIDANCE MANUAL"
**	GO FOR ENGINEERING APPROVAL FOR NON-NSN ITEMS
***	HIGH OR SERIOUS RISK REQUIRES SPECIAL APPROVAL
▬	PROCESS DELAY POINTS

APPENDIX D

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